CENTRAL UTAH PROJECT

STREAM HABITAT STUDIES ON THE UINTA & ASHLEY NATIONAL FORESTS

HENRY P. CHROSTOWSKI
ZONE FISHERY BIOLOGIST

U. S. DEPARTMENT OF AGRICULTURE
FOREST SERVICE
INTERMOUNTAIN REGION
OGDEN, UTAH

1972

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
BUREAU OF SPORT FISHERIES AND WILDLIFE

Room 2225 Federal Building
125 South State Street
Salt Lake City, Utah 84111

March 30, 1972

Mr. H. P. Chrostowski
Fishery Biologist
Uinta National Forest
United States Forest Service
P. O. Box 1428
Provo, Utah 84601

Dear Hank:

We thank you for the opportunity to examine and respond to the Forest Service draft report on "Central Utah Project Stream Studies." Our staff fishery biologists have examined the report along with Jim Mullan of our Division of Fishery Services in Vernal. Mr. Mullan's comments represented very closely those generated by our staff people so we are forwarding a copy of his letter which will form our response to your letter of February 11, 1972.

We want to reiterate Jim Mullan's comments, this is an excellent report reflecting considerable effort on the Forest Services' part. It is hoped that it will be used as a key to obtaining more definative knowledge for determining minimum stream flow requirements. As competative needs for available water supplies develop in the future we must refine our techniques for establishing instream water needs for fish.

Sincerely,

Robert C. Garrison

Robert C. Garrison
Acting Field Supervisor

Enclosure

462340

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
BUREAU OF SPORT FISHERIES AND WILDLIFE

September 8, 1972

Henry P. Chrostowski
Zone Fishery Biologist, USFS
Uinta National Forest
P.O. Box 1428
Provo, Utah 84601

Dear Hank:

Just saw a copy of your work on the Central Utah Project stream habitat studies. This paper would be extremely valuable in our Unit Library for student and staff use. Could you please send us one? If an additional copy is available, I'd appreciate receiving it for my own reprint collection.

Thanks.

Best regards,

Robert H. Kramer
Unit Leader

RHK:gm

Sent from R.O. by Eleanor 9/11/72

UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE
P.O. Box 1428
Provo, Utah 84601

FEB 14 '72

2510
February 11, 1972

Mr. Palmer DeLong, Project Manager
U.S. Bureau of Reclamation
168 West 100 North
Provo, Utah 84601

Dear Palmer:

The Central Utah Project stream studies preliminary rough draft was handcarried to you the other day. It would be appreciated if you would give this a critical review and note any comments or corrections you have in the report and return the report to us. This being a preliminary rough draft, it is quite likely there are some errors in it. You will receive the final draft after comments from the concerned agencies have been incorporated into the report.

We would appreciate receiving the report with your comments by March 31. It is hoped we will be able to furnish you the final draft with project maps by the latter part of May.

Sincerely,

for H. P. Christensen

for
E. P. BOYLE
Forester

UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE
P.O. Box 1428
Provo, Utah 84601

2510
February 11, 1972

Mr. John Peters, Environmentalist
Federal Center, Building 67
Denver, Colorado 80225

Dear Mr. Peters:

The Central Utah Project stream studies preliminary rough draft was mailed to you the other day. It would be appreciated if you would give this a critical review and note any comments or corrections you have in the report and return the report to us. This being a preliminary rough draft, it is quite likely there are some errors in it. You will receive the final draft after comments from the concerned agencies have been incorporated into the report.

We would appreciate receiving the report with your comments by March 31. It is hoped we will be able to furnish you the final draft with project maps by the latter part of May.

Sincerely,

E. P. BOYLE
Forester

United States Department of the Interior
BUREAU OF RECLAMATION
REGIONAL OFFICE - REGION 4
P. O. BOX 11568
SALT LAKE CITY, UTAH 84111

IN REPLY REFER TO: 4-750
565.

APR 26 1972

Mr. Vernon O. Hamre
Regional Forester
Regional Forest Service Office
Federal Building-Room 5124
Ogden, Utah 84401

Dear Mr. Hamre:

We have completed our review of the Central Utah Project Streamflow Studies. Our chief concern about the study is the recommendations for minimum fish bypasses in the Bonneville Unit and Uintah Unit sections of the studies. As for the Upalco Unit, our Definite Plan Report indicates fishery releases are compatible with Forest Service recommendations. Fishery releases of the Ute Indian Unit are not definite at this time and will require further study.

In the review of the Bonneville Unit portion of the Central Utah Project stream studies we have concluded that if the recommended stream bypasses for fish habitat were made there would be a very serious reduction in the amount of water divertible to the Bonneville Basin, and that it would increase the water supply to Starvation Reservoir and the Uinta Basin. The following table summarizes the effect on the Bonneville Unit water supply if all of the Forest Service recommendations were to be met:

Stream	Forest Service Recommended Bypass	Decrease in Strawberry Aqueduct Divertible Flows (acre-feet)
	2/	
Rock Creek	20 cfs	7,300
Wolf Creek	3 cfs	2,400
West Fork Duchesne	8 cfs	4,800
Currant Creek	5 cfs	3,300
Total Loss at Strawberry Aqueduct		17,800
Reservoir Evaporation		2,700
Loss at Strawberry Reservoir (Divertible to Bonneville Basin)		15,100

See footnotes on following page.

Starvation Reservoir

Gross Increased Inflow Starvation		17,800
Reservoir Evaporation		1,100
Net Increased Inflow - Starvation Reservoir	3/	16,700

1/ Bypasses required in addition to planned project bypasses.
2/ At Upper Stillwater Dam.
3/ Starvation Reservoir could store this flow 27 out of 40 years and would spill it 13 out of 40 years.

On some of the Uinta Basin streams intercepted by the Strawberry Aqueduct minimum guaranteed bypasses were not included in the project plan in order to maintain a sufficient project water supply and assure feasibility of the project. On Rock Creek and the Strawberry River 6,500 acre-feet of water will be available to insure minimum fishery flows on these streams or at other points along the aqueduct.

Until the Strawberry Aqueduct diversion structures and Currant Creek and Upper Stillwater Dams are completed and in operation it will not be possible to determine what flows are available immediately downstream from the structures because of unavoidable seepage losses such as at Currant Creek Dam and the occurrence of tributary inflow. During the first years of operation much latitude and flexibility will be available in operating the aqueduct system when studies will be made of the amount of seepage and tributary inflows below diversion points. The Strawberry Aqueduct can be operated to bypass minimum flows in order to study the effects of reduced stream flows on downstream fishery habitat. While it is vital to develop water for project use, adverse effects on the fishery may be reduced through a reasonable and intelligent operation of the Strawberry Aqueduct system. Irrigation shortages in the Bonneville and Uinta Basins will be shared, resulting in reduced diversions into the Strawberry Aqueduct for Strawberry Reservoir. In other words, during drouth periods natural conditions will tend to prevail in streams along the aqueduct, with the possibility of enhancing the fishery in some of the streams by making selective releases from Upper Stillwater Reservoir.

It has been proposed by the Bureau of Sport Fisheries and Wildlife that Section 8 funds in the amount of $267,000 be made available for a 10-year program of study to determine the best possible use of flows, including project storage water made available for fishery conservation.

The Uintah Unit Feasibility Report has included allowances for a minimum of streamflow of 15 second-feet in the Uinta River below Uintah Dam and 7 second-feet of White Rocks River. These minimum flows will maintain some fishery in each of the rivers. Any increase in the above bypasses would be detrimental to project yield for irrigation, municipal and industrial, and other uses.

Sincerely yours,

Regional Director

cc: Project Manager, Provo

[illegible]

[illegible]

Mr. David L. Crandall
Regional Director, Region 4
Bureau of Reclamation
P. O. Box 11568
Salt Lake City, Utah 84111

Dear [illegible]:

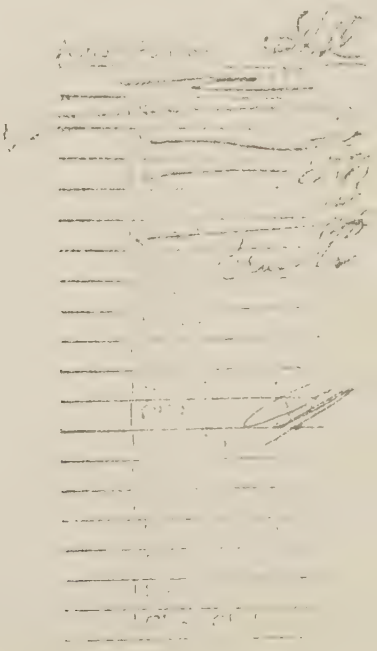
We appreciated your reviewing the draft of our Central Utah Project Streamflow Studies report. The concerns expressed in your letter of April 26 over the possible effects of recommended stream by-passes for fish habitat on current project plans are understandable. We feel, however, that the supporting data and recommendations in the Streamflow Studies should stand on their own merits as part of the Forest Service input into the Central Utah Project planning process.

The Instream Flow Studies report is now being prepared in final form. We will send you copies as soon as they are available.

Sincerely,

[illegible]
Regional Forester

cc:
[illegible]
EPO
CUP Unit



United States Department of Agriculture
Forest Service
R-4

August 25, 1972

ERRATA FOR: Central Utah Project, Stream Habitat Studies on the Uinta and Ashley National Forests

U. S. Department of Agriculture, Forest Service publication

Page 2, paragraph 5, line 4, change the sentence to read "A total of 6,500 acre-feet of water is provided for downstream fishery releases in streams affected by the Strawberry Aqueduct of the Bonneville Unit."

Page 13, line 5, change this sentence to read, "It will cost about one-half billion dollars to construct."

Page 16, Figure 1, under chart, DISCHARGE IN CFS, the figures "52.27" change to "52.07" and the figures "36.04" change to "26.04."

Page 51, second paragraph, first line, change the figures "68,400 acre-feet" to "78,400 acre-feet."

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U.S. DEPARTMENT OF AGRICULTURE
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INTERMOUNTAIN REGION
OGDEN, UTAH

1972

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I. INTRODUCTION

The Central Utah Project is a major multipurpose water resource project and is the largest participating project of the Colorado River Storage Project. Located in the central and east central part of Utah, it is considered to be the most important future water resource development program in the State. When first considered by the Congress of the United States, it was divided into two phases because of its cost, scope, and complexity. It was later divided into six separate units for planning and construction.

The Initial Phase, consisting of the Jensen, Vernal, Upalco, and Bonneville Units, was authorized on April 11, 1956, by Public Law 485, as a participating project of the Upper Colorado River Storage Project. The Vernal Unit of the Initial Phase has been constructed and is now in operation. It is administered by the Uintah Water Conservancy District. The Bonneville Unit, sponsored by the Central Utah Water Conservancy District, is under construction. Funds have been made available to start construction on the Jensen Unit. It is anticipated that funds will soon be made available to start construction on the Upalco Unit.

The Ultimate Phase includes the Uintah and Ute Indian Units. The Uintah Unit was authorized by Congress in 1968, and final construction plans are now being prepared. Feasibility studies have been authorized for the Ute Indian Unit before submitting it to Congress for authorization.

Through compacts with other Colorado River Basin States, Utah's entitlement to the Colorado River is approximately 1.5 million acre-feet of water per year. Through the Central Utah Project, Colorado River water would be exported into Bonneville Basin for use in the Salt Lake-Wasatch Front area and also exported into the Sevier River Drainage. Sixty percent of Utah's contribution to the Colorado River Drainage Basin is produced in the Uinta Mountains. This is the area from which the Central Utah Project would obtain their water for export into Bonneville Basin. If plans as have been proposed in the six units are constructed, water would be diverted from Little Brush Creek in the eastern part of the basin westerly, intercepting all major streams on the south face of the Uintas and westward to Strawberry River. (See maps for each unit in the report.)

The Forest Service, in cooperation with the Bureau of Reclamation, Bureau of Sports Fisheries and Wildlife, and Utah Division of Wildlife Resources, has conducted surveys on all of the streams that would be affected by these units. These surveys have been

aimed at obtaining the habitat information to justify the amount of water that would be required to maintain a fishery habitat in the streams below the point of diversions. This study has been going on since the fall of 1962, and the last information was gathered in 1970.

Two units, Vernal and Jensen, in the Initial Phase are outside of the National Forests; and no studies were done to determine the required streamflows below the diversions on these projects. The following information is only applicable to the areas inside of the National Forests, and nothing will be reported on the Vernal or Jensen Units. This report is broken into four sections covering the Bonneville and Upalco Units of the Initial Phase and the Uintah and Ute Indian Units of the Ultimate Phase.

SUMMARY

The Central Utah Project is dependent upon the collection and storage of winter and high spring flows in streams along the south and west face of the Uinta Mountains. The natural low flows in these streams during the winter months are also critical to the preservation of the aquatic habitat and carrying capacity for the survival of fish populations and food-producing organisms.

A survey of some major streams to be affected by the Central Utah Project was undertaken in 1962 and completed in 1970. The objective was to determine the amount of winter flows which could be retained in the streams without degrading the existing aquatic habitat to where irreparable losses would occur through the diversion of these flows into the aqueduct system. Analysis of collected field data resulted in recommended release flows below diversion points or other project features as indicated in Table 1.

Recommended releases below proposed diversion points or reservoir dam sites are essentially minimum flows necessary to sustain the aquatic habitat and preserve the natural fisheries during the non-irrigation season when streamflows are diverted. A total of 6,500 acre-feet of water is provided for downstream fishery releases in streams affected by the Bonneville Unit. The recommended releases to sustain aquatic habitat in affected streams will require 17,800 acre-feet excluding the Strawberry River below Soldier Creek Dam located off the Forest.

TABLE 1

RECOMMENDED MINIMUM RELEASE FLOWS ON STREAMS AFFECTED BY THE CENTRAL UTAH PROJECT

Unit	Stream	Project Feature	Recommended Release	Project Planned Water Release
Bonneville Unit	Rock Creek	Upper Stillwater Reservoir	20 c.f.s.	25 c.f.s. below Lower Stillwater[1/]
	Hades Creek	Hades Diversion Dam	None	None
	Wolf Creek	Rhodes Diversion Dam	3 c.f.s.	None
	Twin Creek	Win Diversion Dam	None	None
	West Fork Duchesne	Vat Diversion Dam	8 c.f.s.	None
	Currant Creek	Currant Creek Dam	5 c.f.s.	None
	Layout Creek	Layout Diversion Dam	None off Forest	None
	Water Hollow	Water Hollow Diversion Dam	None off Forest	None
	Strawberry River	Soldier Creek Dam	None off Forest	5 c.f.s.[2/]
	Sixth Water	Sixth Water Dam	Natural flows into reservoir	Natural flows into reservoir
	Diamond Fork	Dyne Powerplant	Maximum flow restriction undetermined	

[1/] The proposed release of 25 cfs below Stillwater Reservoir at the Ute-Ouray Indian boundary does not provide for an adequate release at Upper Stillwater Reservoir to meet recommended fishery habitat requirements between the two reservoirs.

[2/] The release of 5 cfs at Soldier Creek Dam is well below the recommended release of 12 cfs proposed in the BSFW Initial Phase Report of September 25, 1965.

TABLE 1 (continued)

RECOMMENDED MINIMUM RELEASE FLOWS ON STREAMS AFFECTED BY THE CENTRAL UTAH PROJECT

Unit	Stream	Project Feature	Recommended Release	Project Planned Water Release
Upalco Unit	Yellowstone River	Boneta Diversion Dam	25 c.f.s.	25 c.f.s.
	Lake Fork River	Moon Lake Reservoir to Taskeech Reservoir	17 c.f.s.	30 to 15 c.f.s. Operational
Uintah Unit	Uinta River	Present diversion canal to Uinta Reservoir	Undetermined	15 c.f.s.
	Whiterocks River	Whiterocks Dam	17 c.f.s.	7 c.f.s.[3/]
Ute Indian Unit	Little Brush Creek	East Park Reservoir Enlargement	4 c.f.s.	Under Study
	Big Brush Creek	Diversion dam	3 c.f.s	Under Study
	Ashley Creek	Leidy Dam (Trout Creek Dam)	5 c.f.s.	Under Study
	Dry Fork Creek	Dry Fork Dam	None	Under Study
	East Fork Dry Fork	Diversion dam	None	Under Study
	Whiterocks River	Lake Ashley Dam	20 c.f.s.	Under Study
	Uinta River	Burro Dam	40 c.f.s.	Under Study
	Yellowstone River	Tawanta Dam	14 c.f.s.	Under Study

[3/] The proposed project release of 7 cfs is inadequate to sustain the downstream aquatic habitat.

II. PURPOSE AND SCOPE

The purpose of the stream habitat surveys and water discharge studies conducted by the Forest Service was to determine the minimum sustained flows necessary to retain the aquatic habitat in streams which would be affected upon completion of the various phases of the Central Utah Water Project.

The surveys were made in conjunction with the intent and purposes stated in The Multiple Use and Sustained Yield Act, Public Law 86-517 (74 Stat. 215) "...It is the policy of the Congress that the National Forests are established and shall be administered for outdoor recreation, range, timber, watershed, and wildlife and fish purposes...."

Sustained minimum flows are generally those flows adequate to maintain the existing aquatic habitat. Further decreases in discharge would be detrimental to fish and other life organisms dependent on the aquatic habitat for their survival.

Habitat requirements may vary from stream to stream and even throughout the length of a stream. Natural physical habitat characteristics are influenced by fluctuating levels of flow at given periods throughout the year, weather conditions, temperature, normal minimum flows, streambottom conditions, velocity, slope, streambanks, and other factors.

The determination of minimum flows to retain or lessen the impact on the existing aquatic habitat was made in conjunction with natural low flows, particularly during the critical winter months when flows will be diverted. The availability of water, with respect to diversions and other water manipulations to be associated with the Central Utah Project, was not considered in the normal relationship of discharge reductions and habitat requirements.

The objective to retain sufficient streambottom coverage and a favorable depth for existing pools is not intended to imply the fisheries will remain the same after the streams are altered. Retention of at least 80 percent of the low flow aquatic habitat does not guarantee 100 percent or even 80 percent retention of the fishery. Indigenous populations may vary considerably. Conservation of the basic habitat will provide necessary requirements for food production and suitable cover.

III. PREVIOUS STUDIES

A preliminary report containing recommendations for minimum flows in some project streams associated with the Initial Phase of the Bonneville (1964) and Upalco (1967) Units, was prepared by the Forest Service. The original field data have been reviewed and incorporated into this study to determine the validity of those recommendations.

An intensive and comprehensive study of aquatic habitat and discharge relationship was conducted by the State of Colorado for the White River from July 11, 1962, to April 15, 1963, under Project No. F-26-R-1[a]. Their study, which included water diversions below normal low flow periods, indicated aquatic habitat types are influenced particularly by depth, volume, velocity of water, and bottom characteristics. An important feature of the project showed that as the rate of discharge of a stream is reduced, several water factors are also reduced in the following order of magnitude. Velocity is affected the most, then volume, depth, and water surface the least. With a reduction in discharge, pool areas are reduced because of lesser depth; deep fast riffle areas and velocity are lowered; riffle areas are reduced to slow shallow areas; and slow shallow areas tend to become dry rock. The net effect of these changes depends on the characteristics of individual streambed sections and the extent of discharge reduction.

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[a] Refer to List of References in the Appendix.

IV. METHODS AND PROCEDURES

Each project stream was sampled to determine the potential aquatic habitat value in relation to existing low base flows. The Stream Habitat Inventory and Analysis Techniques developed by the Division of Wildlife Management for Region 4 was used. This is a stream sampling method which emphasizes evaluation of the physical features of the water course for their potential value as aquatic habitat. Permanent channel cross section discharge stations were also established at selected sites on each stream for annual measurement and comparison of flows. Discharge measurements were usually taken in October when natural water flows were relatively low and access was still available to the streams.

Physical habitat features included evaluation of such factors as pool-riffle ratio, pool structure or quality, water surface width, wetted perimeter, water depth, streambottom materials, streambank cover, streambank stability, stream gradient, and discharge velocity.

To locate sample stations in the field, aerial photos and 2-inches-to-the-mile scale maps were used. Sample points were located at 1-mile intervals beginning at the Forest boundary up to and including the location of the particular project feature. Each sample point was located as precisely as possible by field personnel utilizing aerial photos and scale maps as reference points. As each station was located, habitat data collection would begin at a point 50 feet upstream from the sample point. Each sample section comprises 10 cross section stations measured at 50-foot intervals along the baseline of the stream for a total distance of 450 feet from the initial cross-channel station. The number of 10 stations was later reduced to 5 stations for each sample on other streams later in the study to reduce field time. The statistical validity of the survey was not affected by this change of a 450-foot sample to a 250-foot sample.

Habitat features at each station were determined by stretching a tape across the stream channel at a right angle to the control bank. Physical habitat components consisting of channel width, water surface, streambottom composition, and pool-riffle ratio were recorded to the nearest foot. Depth was recorded to the nearest tenth of a foot. Habitat components were then grouped into four categories for each station.

A. Pool-riffle measure. A ratio of the total sample width as pool and riffle habitat.

B. Pool structure. A rating of the percent of the total pool width which contained pools of good quality. Pool rating criteria are contained in the habitat inventory techniques on file with the Division of Wildlife Management. Pool ratings are based on pool size and depth in relation to stream width.

C. Streambottom. The ratio of the total sample width containing boulder, rubble, gravel, and silt. Aquatic vegetation was also measured.

D. Stream environment. A rating of the streambank vegetative cover in descending order of trees, brush, and exposed banks.

The ratings from all four categories were summed and then divided by the maximum sum possible (400) to obtain the sample rating identified as the habitat "percent of optimum." This rating is indicative of the habitat quality of the particular sample and of the stream as a whole when all stations were summed together.

A detailed appraisal of the habitat physical features associated with existing discharge flows was necessary to determine the minimum flow which would provide for water in the channel and still maintain habitat values.

Permanent channel discharge cross sections were measured for water surface, depth, and friction factor. The channel slope (gradient) was also recorded. A standard Gurley current meter was used by the hydrologist to measure discharge and calculate velocity of flow. A visual representation of the channel cross section was than plotted on graph paper at three different water stages. The hydraulic geometry features of the cross section at each water level for water surface, wetted perimeter, and area were determined utilizing a planimeter. Calculations for velocity of flow, discharge, and friction index (n) were also made for each water stage utilizing Manning's formula.[1]

---

[1] $V = \frac{1.486}{n} \times r^{2/3} \times s^{1/2}$

$n = \frac{1.486}{n} \times r^{2/3} \times s^{1/2}$

Where: V = velocity of flow
n = coefficient of friction of flow
$r = \frac{A}{P}$ where A = wetted area and P = wetted perimeter
s = channel slope or gradient

$Q = AV$

Where: Q = discharge in c.f.s.
A = area
V = velocity

A graph was then prepared for each representative cross section indicating plotted points of the hydraulic features at each water level for the habitat appraisal of field-measured values. Each of the field-measured values for water surface, wetted perimeter, average depth; and the aquatic habitat value is the base point indicated as 100 percent at the upper left-hand margin of the graphic illustrations, indicating the habitat trend-discharge relationship.

V. RESULTS OF SURVEYS

The relationship of habitat to discharge when habitat data points such as pool measure, pool structure, streambottom, stream environment and discharge are compared is expressed in either a linear or curvilinear form. Analysis of habitat data indicated that in curvilinear forms, "sharp breaks" on the trend line are representative of habitat significantly degraded from field-measured values. Distinct sharp breaks are usually found along the field value axis above the 80 percent graph line. It is assumed that linear habitat forms would also become significantly altered below the 80 percent habitat value points. Interpretation of the curvilinear format indicates that habitat preservation requires a minimum flow equal to no less than 80 percent retention of low flow habitat value. Analysis of the habitat data along shallow sloping trend lines between sharp breaks requires some judgment to be exercised by the biologist in estimating absolute minimum flows which would not degrade habitat values to the point where the aquatic habitat is lost.

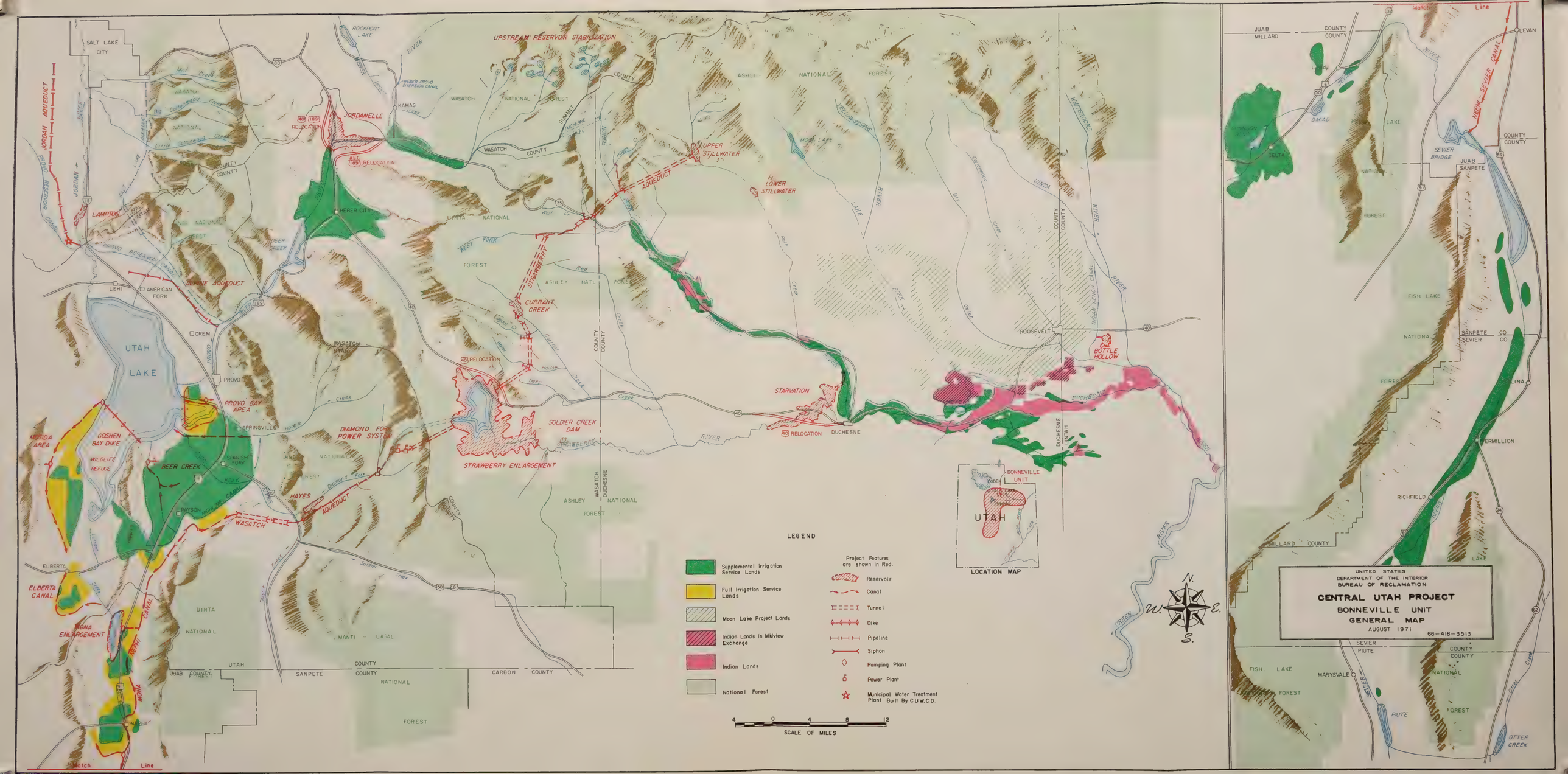
The recommended sustained minimum flows were then compared with historical water records maintained by the U.S. Geological Survey. In addition, flow duration curves were also used for further comparison of the recommended minimum flows on project streams monitored by gages.

All field data compiled for the Central Utah Project Study can be reviewed by contacting the Forest Supervisor, Uinta National Forest.

Minimum flows are recommended for each discharge station on study streams to indicate the variety of stream requirements. The basic recommendation for downstream releases from diversion points will be the discharge necessary to sustain the aquatic habitat and fisheries below these points during the low flow months. Variance in recommended flows at different streams was considered in the overall recommendation for the entire stream within National Forest boundaries.

Proposed water releases for irrigation, municipal, or other uses, utilizing existing stream channels, should not have to great an adverse effect on the existing aquatic habitat. These discharge releases will be well below velocities which would normally degrade stream channels and not exceed volumes which would be detrimental to fishing. One exception to the above releases is the discharge in Diamond Fork Creek below the Dyne Powerplant.

The most basic general requirement in determining minimum flows was to retain a favorable depth for existing pools and sufficient stream bottom coverage. A pool-riffle association is generally a characteristic of good streams which provide necessary cover, food production, and spawning areas. Pool areas without some turbulence are more conducive to the growth of suckers than trout. The general habitat requirements for trout must be retained to prevent the incursion of competitive non-trout species.


UPSTREAM RESERVOIR STABILIZATION
JORDAN AQUEDUCT
JORDANELLE
UPPER STILLWATER
LOWER STILLWATER
CURRANT CREEK
STRAWBERRY
SOLDIER CREEK DAM
STRAWBERRY ENLARGEMENT
DIAMOND FORK POWER SYSTEM
STARVATION
BOTTLE HOLLOW
ALPINE AQUEDUCT
PROVO BAY AREA
GOSHEN BAY DIKE
WILDLIFE REFUGE
MUSIDA AREA
BEER CREEK
HAYES
AQUEDUCT
WASATCH
ELBERTA CANAL
MONA ENLARGEMENT
NEPHI CANAL
MONA
UTAH LAKE
SALT LAKE CITY
LAMPTON
LEHI
AMERICAN FORK
OREM
PROVO
SPRINGVILLE
SPANISH FORK
PAYSON
ELBERTA
HEBER CITY
ROCKPORT LAKE
WEBER PROVO DIVERSION CANAL
KAMAS
MOON LAKE
ROOSEVELT
DUCHESNE
BONNEVILLE UNIT
LOCATION MAP
UTAH
NEPHI - SEVIER CANAL
LEVAN
JUAB
MILLARD
SANPETE
SEVIER
FISH LAKE
VERMILLION
RICHFIELD
MARYSVALE
PIUTE
OTTER CREEK
WASATCH NATIONAL FOREST
ASHLEY NATIONAL FOREST
UINTA NATIONAL FOREST
MANTI - LASAL NATIONAL FOREST
Match Line
LEGEND
Supplemental Irrigation Service Lands
Full Irrigation Service Lands
Moon Lake Project Lands
Indian Lands in Midview Exchange
Indian Lands
National Forest
Project Features are shown in Red.
Reservoir
Canal
Tunnel
Dike
Pipeline
Siphon
Pumping Plant
Power Plant
Municipal Water Treatment Plant Built By C.U.W.C.D.
SCALE OF MILES
4 0 4 8 12
N.
W.
E.
S.
UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
CENTRAL UTAH PROJECT
BONNEVILLE UNIT
GENERAL MAP
AUGUST 1971
66-418-3513

The largest unit of the Initial Phase of the Central Utah Project is the Bonneville Unit. The unit is extremely complicated.

Involved in the construction are dams, pipelines, aqueducts, canals, diversion dams, pumping plants, dikes, powerplants, and exchanges of water. It will cost approximately $490,000 to construct. Construction will take from 15 to 20 years to complete. Water from the Uinta Mountains will be diverted through the Strawberry Aqueduct to the enlarged Strawberry Reservoir, then to Utah Valley for further distributions to points both north and south. The streams involved in the Strawberry Aqueduct that will be diverted are, starting on the east, Rock Creek, Hades Creek, Wolf Creek, Twin Creek, West Fork of Duchesne, Currant Creek, Layout Creek, Water Hollow Creek and Strawberry River. Strawberry River, which is a quality trout fisheries, is not being covered in this report because it is outside of the National Forest boundaries. Water will be released from Strawberry Reservoir into the pressurized Syar Tunnel through Great Basin Divide. It will then pass into the Syar, Sixth Water, and Dyne Powerplants into Diamond Fork Creek, the Hayes Reservoir, and the Wasatch Aquduct. These plants, known as the Diamond Fork Power, are designed to generate 133,000 kilowatts of electricity and 320,000,000 kilowatt-hours of electric energy annually. This will be more power capacity than is available at Flaming Gorge Reservoir. As the water comes down Diamond Fork Canyon, it will either be stored in the new Hayes Reservoir or be diverted into the Wasatch Aqueduct to flow south into Juab County and the Sevier River Basin. Hayes Reservoir will release water into Utah Lake and also to the southern part of Utah County for municipal and agricultural purposes. The 32-mile Wasatch Aqueduct will traverse the base of the mountains above the existing Strawberry highline canal and the area between the aqueduct and the canal will receive a full water supply. Water will flow by gravity into the Mona-Nephi Canal and south to the Nephi area. Land in Juab County will receive both the municipal and irrigation water from the project. Water will also be pumped over Levan Ridge in the Nephi-Sevier Canal to help relieve frequent water shortages in Sevier River Basin. This report will have recommendations on the Sixth Water and Diamond Fork streams but will not comment on releases below Hayes into the Spanish Fork drainage because this is outside the National Forest boundary.

Rock Creek

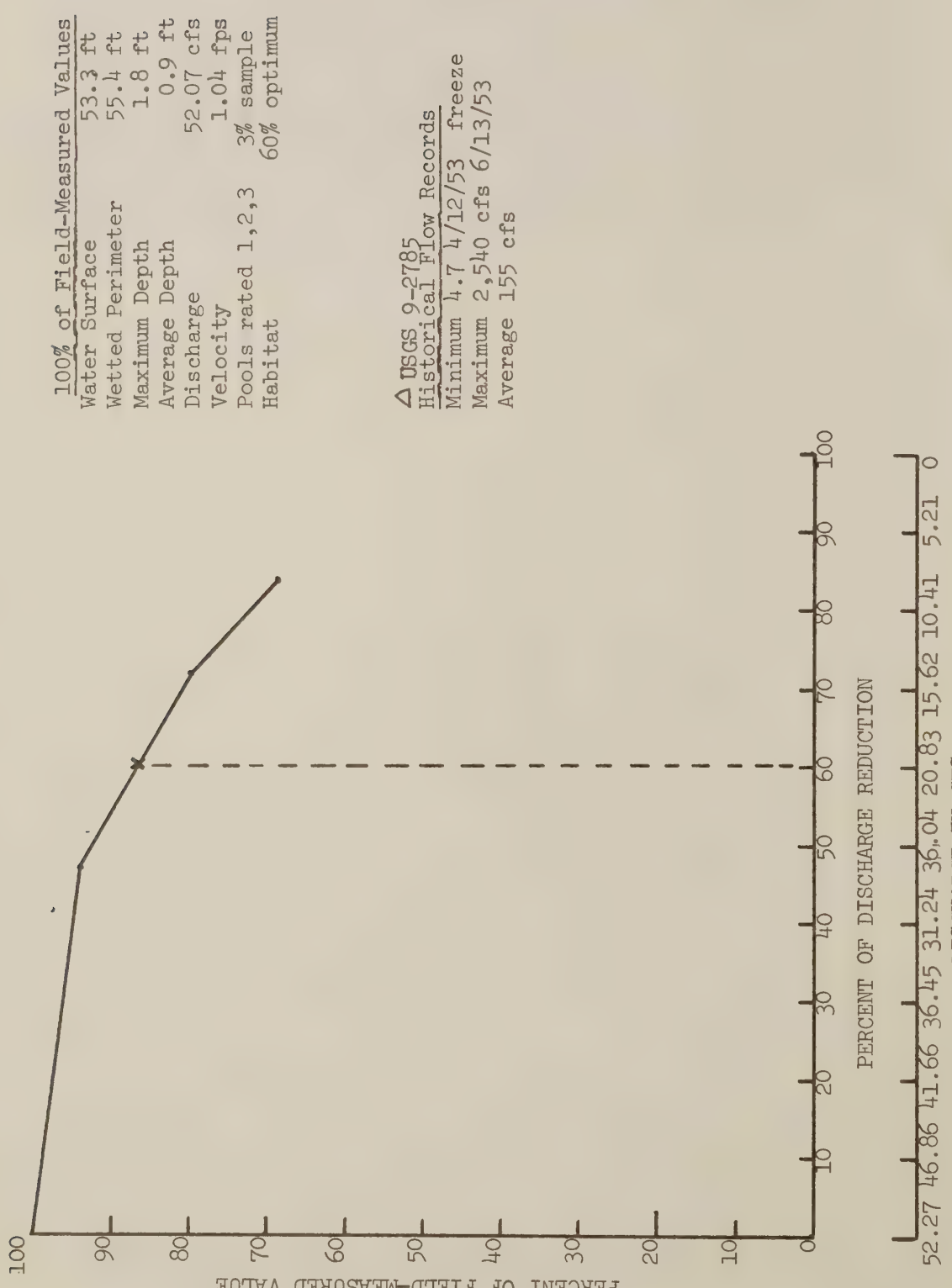
A minimum continuous flow release of 20 cfs from Upper Stillwater Reservoir measured at the dam site is recommended to sustain the aquatic habitat in Rock Creek during the low flow winter months.

The basis for this determination is illustrated in graphic form for each station. In addition, a comparison of the recommended discharge is shown in relation to historical flow records compiled by the U.S. Geological Survey.

Station 1, Rock Creek

The habitat-discharge reduction relationship (Figure 1) indicates the first major degradation in the habitat trend line from the measured base flow occurs at a discharge reduction of about 28 cfs. Habitat values at this point remain about 94 percent of the measured physical stream characteristics. A further reduction in discharge to about 20 cfs from the base flow will still provide 86 percent of the habitat features. Flow reductions below this point would accelerate habitat losses to a dangerously low recovery level. Habitat losses with respect to depth, area, and streambottom features are also shown in relation to the base water stage and three levels of discharge reduction (Figure 2).

Figure 1
ROCK CREEK
Station #1 - 150 feet below footbridge
below Upper Stillwater Campground



Scale:
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Vertical 1" = 1 ft

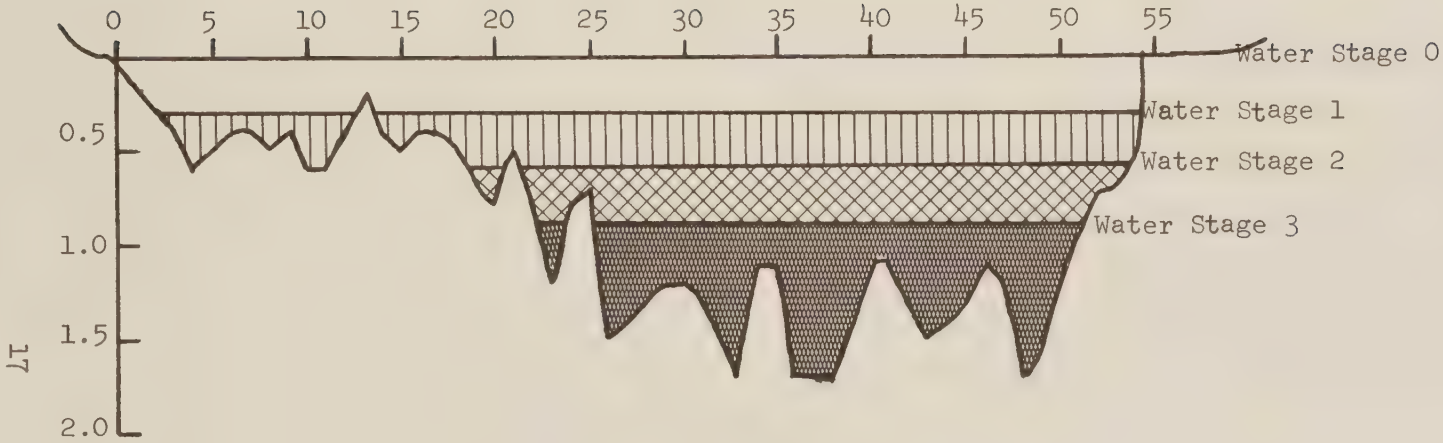


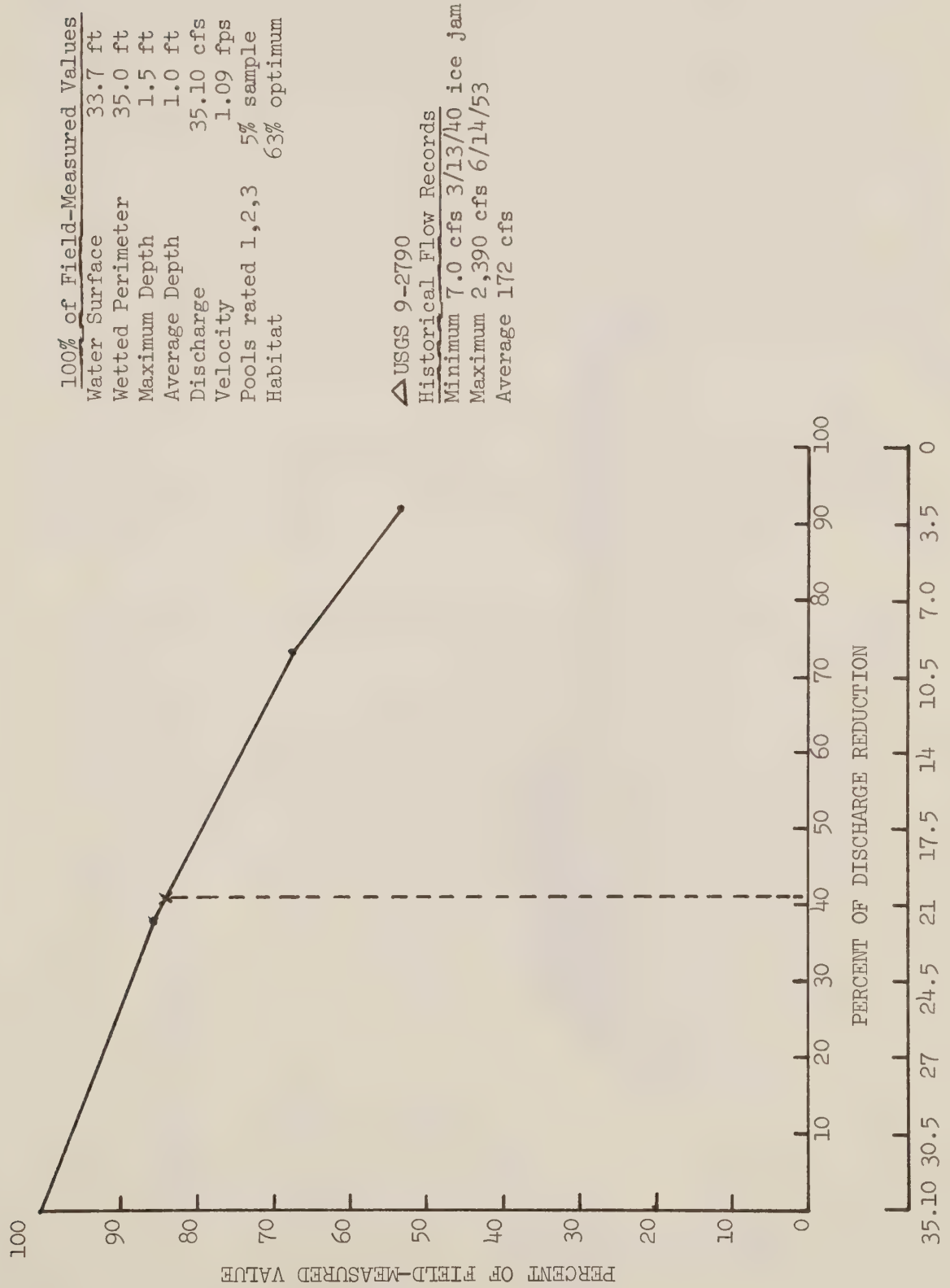
Figure 2
ROCK CREEK
Station #1 - 150 feet below footbridge
below Upper Stillwater Campground

Water Stage	Discharge	%	Velocity	%	Max. Depth	%	Ave. Depth	%	Area	%	Water Surface	%	Wetted Perimeter	%	Habitat Retained	%
0	52.07 cfs	100	1.04 fps	100	1.8 ft	100	0.9 ft	100	49.87 sqft	100	53.3 ft	100	55.4 ft	100	63% opt	100
1	27.65 cfs	53	0.82 fps	79	1.5 ft	83	0.7 ft	78	33.72 sqft	68	51.0 ft	96	53.0 ft	96	56% opt	94
2	14.48 cfs	28	0.73 fos	70	1.2 ft	67	0.6 ft	67	19.84 sqft	40	35.4 ft	66	37.2 ft	67	48% opt	80
3	8.44 cfs	16	0.66 fps	64	0.9 ft	50	0.4 ft	44	12.80 sqft	26	26.2 ft	49	27.9 ft	50	41% opt	69

Station 2, Rock Creek

A discharge reduction from the base measured flow of about 35 cfs to 20 cfs would maintain habitat values at 84 percent of the field measured characteristics (Figure 3). Habitat features retained at this station would be acceptable. Physical habitat losses from the base measured flow for three stages of discharge reduction are shown in Figure 4.

Figure 3
ROCK CREEK
Station #2 - 250 feet above U.S.G.S. Gage and inflow pt. 9-2785



Scale:
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Vertical 1" = 1 ft

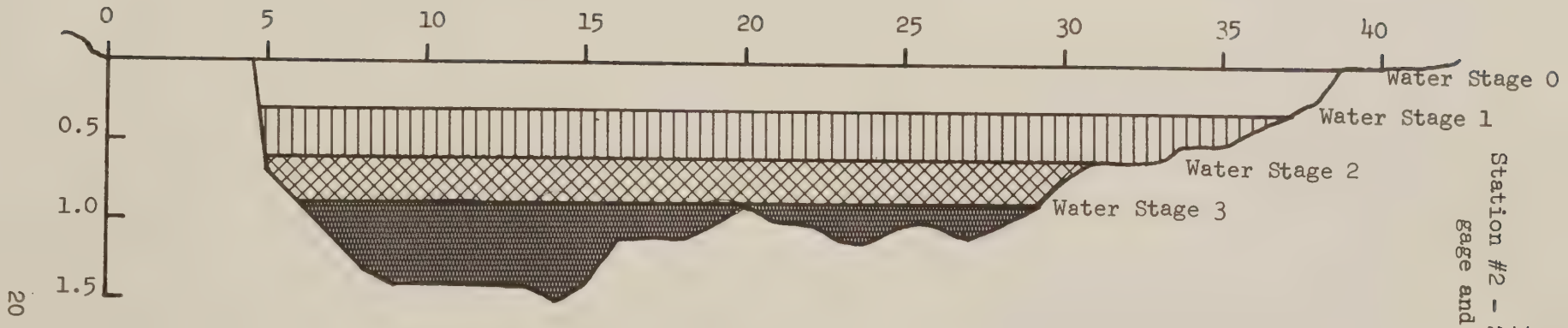

Figure 4
ROCK CREEK
Station #2 - 250 feet above U.S.G.S. gage and inflow pt. 9-2785

Water Stage	Discharge	%	Velocity	%	Max. Depth	%	Ave. Depth	%	Area	%	Water Surface	%	Wetted Perimeter	%	Habitat Retained	%
0	35.10 cfs	100	1.09 fps	100	1.5 ft	100	1.0 ft	100	32.20 sqft	100	33.7 ft	100	35.0 ft	100	63% opt	100
1	21.81 cfs	62	0.94 fps	86	1.2 ft	80	0.7 ft	70	23.20 sqft	72	32.0 ft	95	33.0 ft	94	54% opt	86
2	9.46 cfs	27	0.72 fps	66	0.9 ft	60	0.5 ft	50	13.16 sqft	41	26.4 ft	78	27.1 ft	77	43% opt	68
3	2.93 cfs	8	0.48 fps	44	0.6 ft	40	0.3 ft	30	6.12 sqft	19	22.3 ft	66	23.2 ft	66	34% opt	54

Rock Creek is an excellent fishing stream sustaining populations of game fish including brown trout, brook trout, and whitefish. Periodic stocking of rainbow trout is also made to supplement the indigenous fishery.

The waters of Rock Creek are classified by the Utah Division of Natural Resources as both Class II and Class III waters.[b] The highest rated section, Class II waters, is located within the National Forest boundary. Class I waters represent the highest rating and Class VI, the poorest. The State of Utah contains only 61.8 miles of Class I streams and 450.9 miles of Class II streams. This 512.7 miles represents only about 10 percent of Utah's 5,377 miles of stream. Approximately 2,109 miles of former trout habitat has been eliminated. The remaining 3,268 miles of trout habitat, in streams of varying size and quality, are generally in small streams or streams that are relatively unproductive.

The definition of Class II water for Utah states, "...fishing and other recreation uses should be one of the primary uses. Developments on these class waters, which are the second most important in the State, should not decrease any fishery or other recreational values."[b]

The recommended minimum flow of 20 cfs is in accord with the previous recommendation contained in the Forest Service's 1964 preliminary report on the Initial Phase of the Bonneville Unit.

Comparison of the recommended flow of 20 cfs with the average high, low, and mean historical monthly flow records for USGS gages 9-2785 and 9-2790, located on Rock Creek, is shown in Figures 5 and 6. The relationship of the flow duration curve for USGS gage 9-2790 is shown in Figure 7.[c] The flow curve graph illustrates a flow of 20 cfs would be attainable approximately 100 percent of the time under natural conditions.

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[b]Refer to List of References in the Appendix.

[c]Refer to List of References in the Appendix.

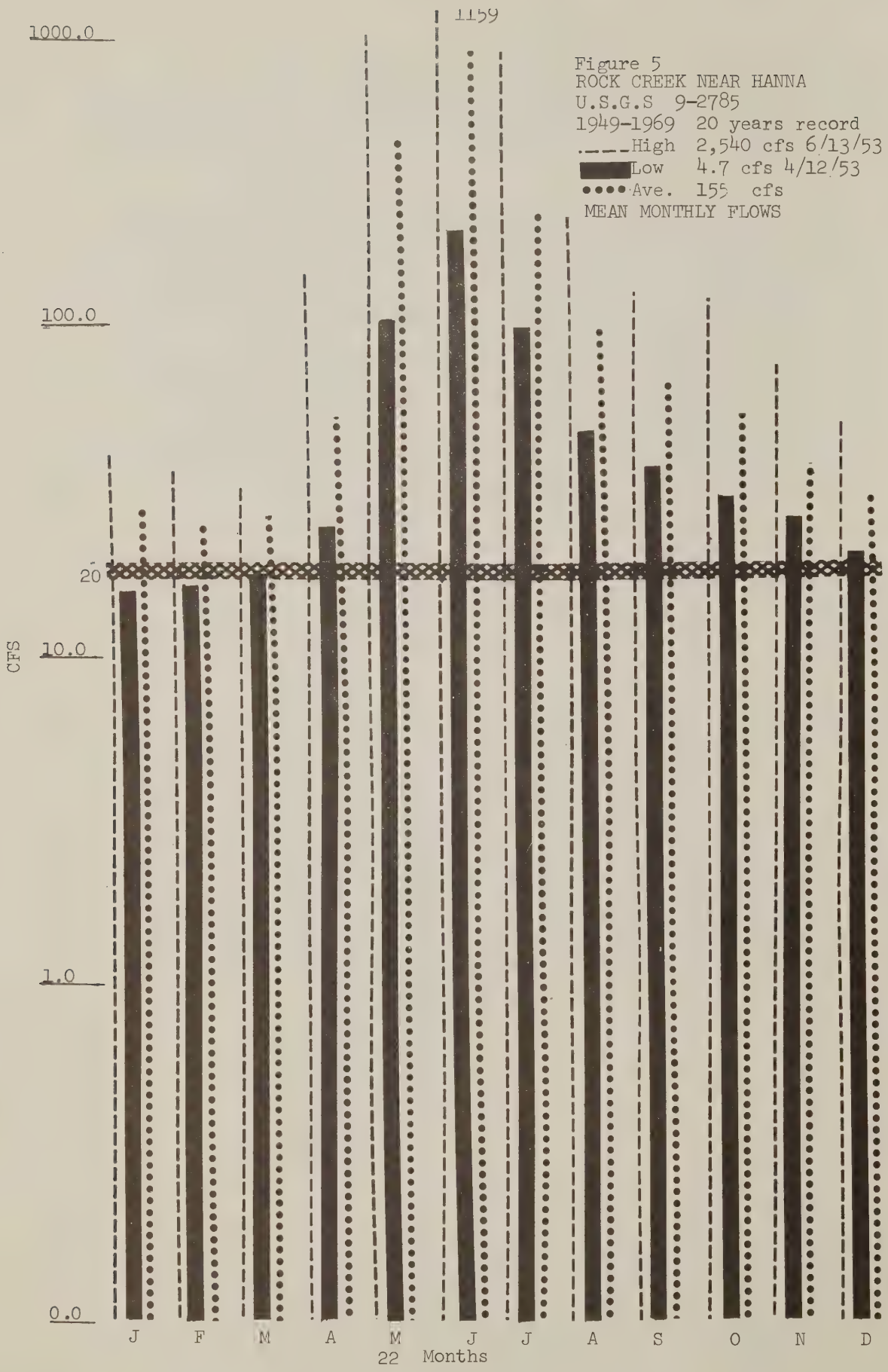


Figure 5
ROCK CREEK NEAR HANNA
U.S.G.S 9-2785
1949-1969 20 years record
High 2,540 cfs 6/13/53
Low 4.7 cfs 4/12/53
Ave. 155 cfs
MEAN MONTHLY FLOWS

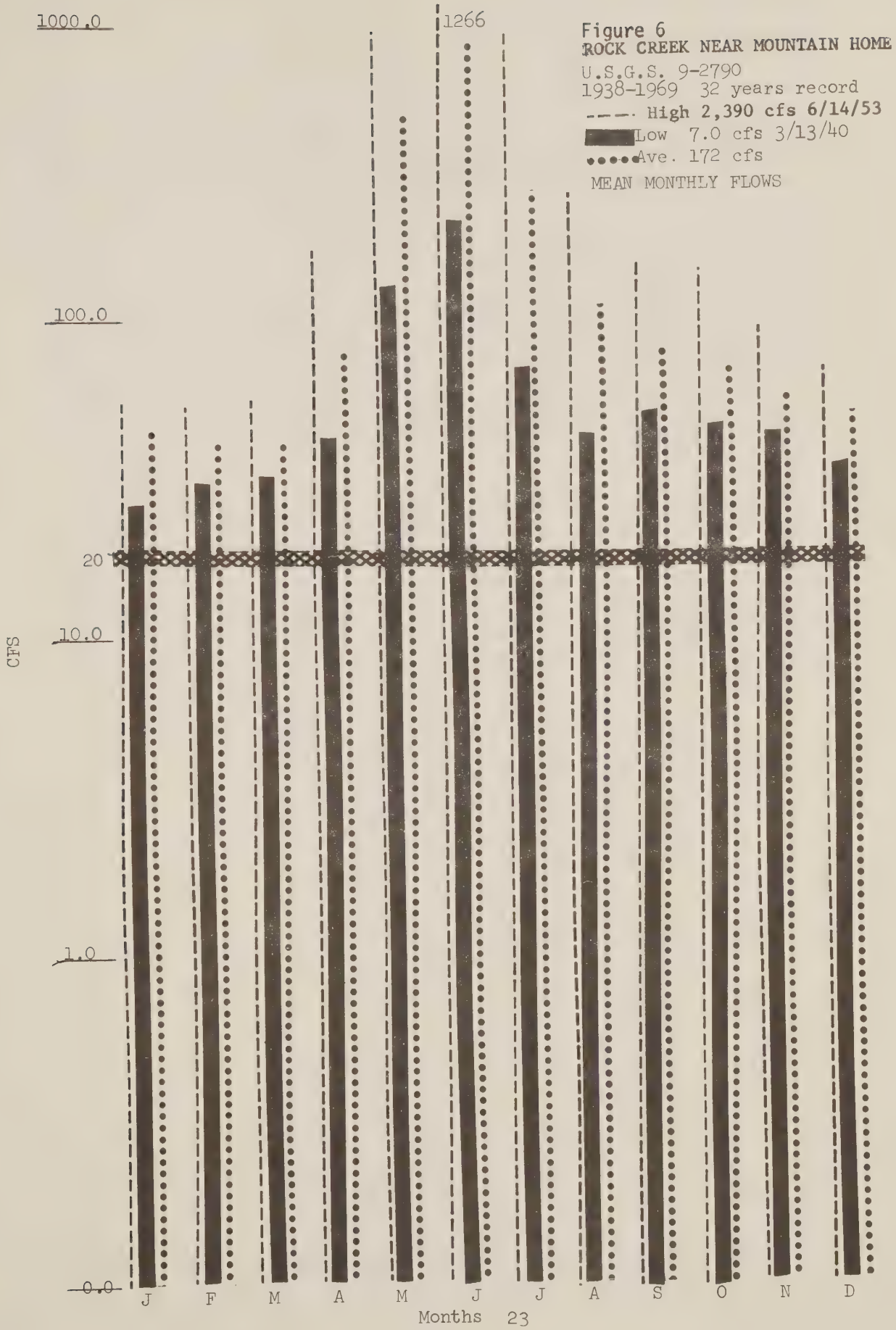


Figure 6
ROCK CREEK NEAR MOUNTAIN HOME
U.S.G.S. 9-2790
1938-1969 32 years record
---- High 2,390 cfs 6/14/53
Low 7.0 cfs 3/13/40
Ave. 172 cfs
MEAN MONTHLY FLOWS

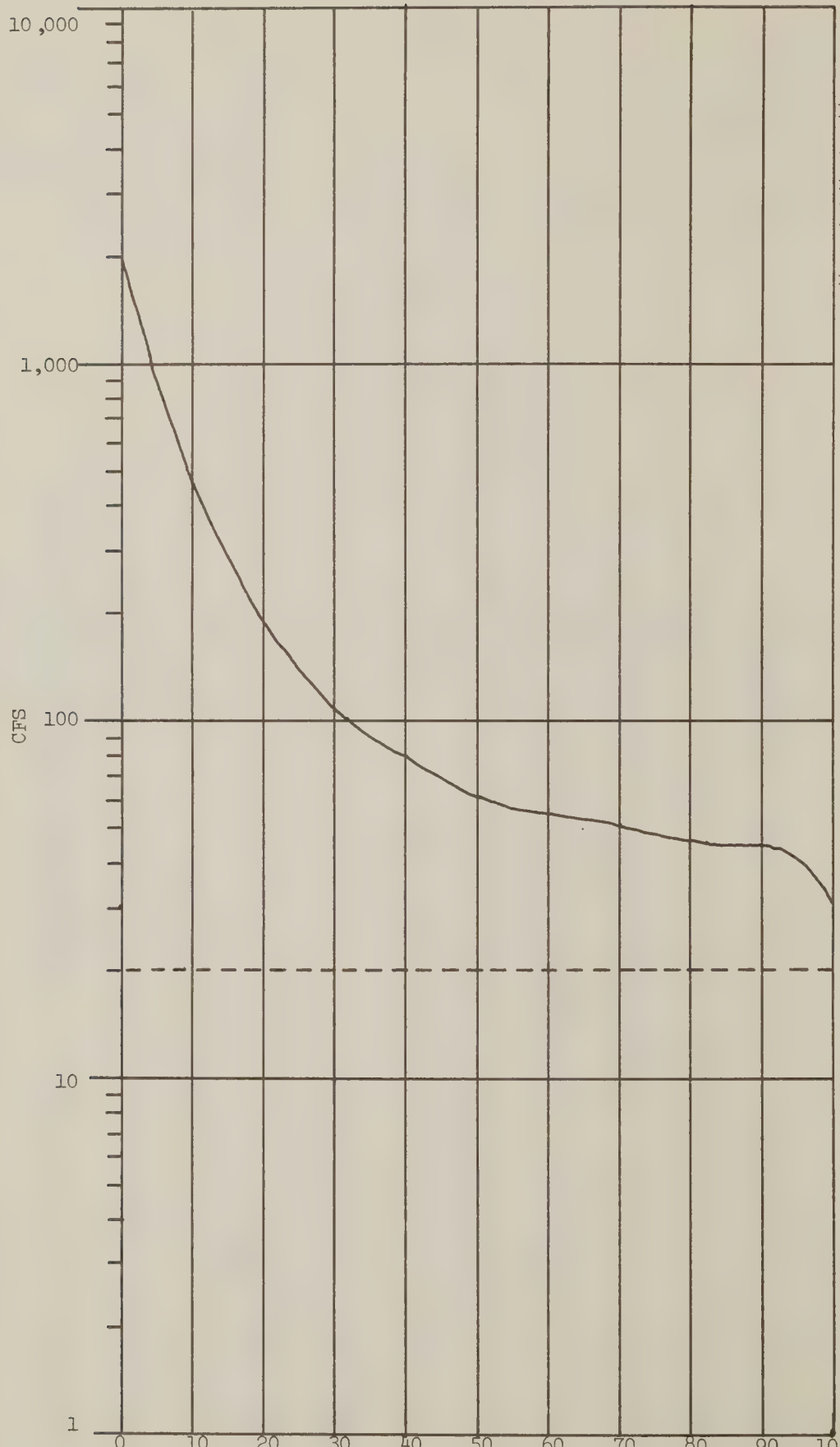


Figure 7

Station No. 2790

Rock Creek near Mountain Home, Utah, 1938-57, not adjusted.

Daily discharge in cfs that was equaled or exceeded for indicated percentage of time.

Currant Creek

The Currant Creek Dam and Reservoir will affect downstream flows of approximately 5 miles of stream within the Forest and about 28.5 miles of stream outside the Forest boundary.

Currant Creek waters are rated as Class II and Class IV fishing waters.[b] The upper section of Currant Creek, located within the National Forest, contains the portion of stream with the high Class II rating. Developments on these waters, as noted previously in the report, should not decrease the fishery or other recreation uses. Currant Creek sustains game fish populations of brown and cutthroat trout. Periodic plantings of rainbow trout catchables supplement the native stocks. Some brook trout fingerlings are also occasionally planted in the stream.

An continuous release of not less than 5 cfs is recommended to sustain the aquatic habitat in Currant Creek. Recommended flows at different stations vary according to the physical stream characteristics at these particular points. A release of 5 cfs is estimated to meet the habitat requirements for the total stream within the Forest boundary. Four stream discharge stations were established on Currant Creek.

[b]Refer to List of References in the Appendix.

Station 1, Currant Creek

A reduction in flow from the base measured flow of 5 cfs to 3 cfs should retain the physical habitat characteristics at approximately 89 percent of the field-measured values. A graphic presentation of the habitat-discharge trend relationship curve is shown in Figure 8.

The cross section habitat losses of depth, area, and stream-bottom features at three water stage reductions from the base flow of 5 cfs is shown in Figure 9. A release of 5 cfs is required to compensate for the loss of flow from Layout Creek which is diverted by the Layout Diversion Dam.

Figure 8
CURRANT CREEK
Station #1 - below dam site - 130 yards below axis

Scale:
Horizontal 1" = 2 ft
Vertical 1" = 1 ft

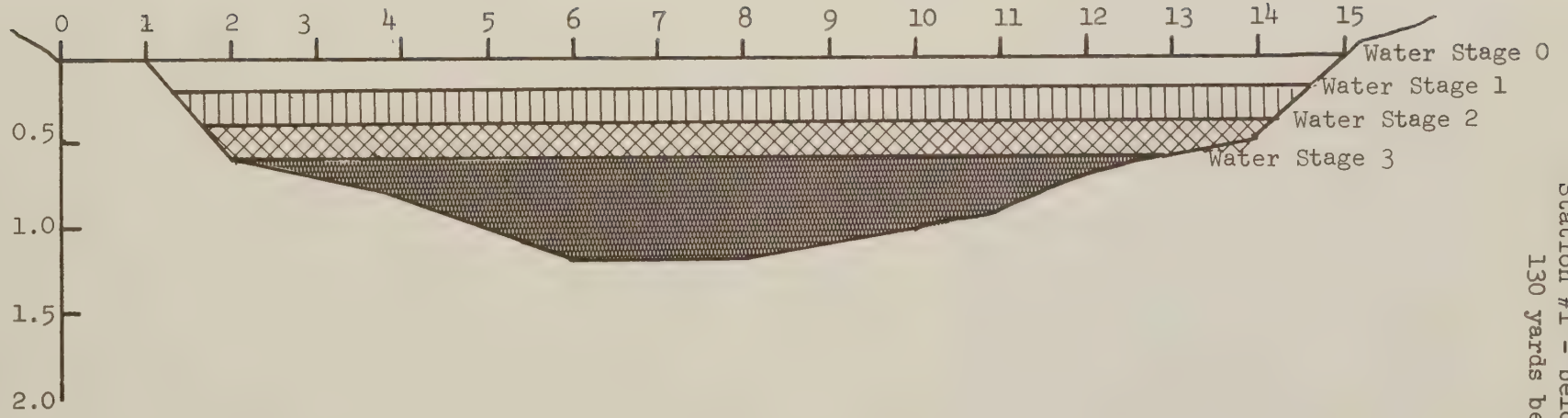


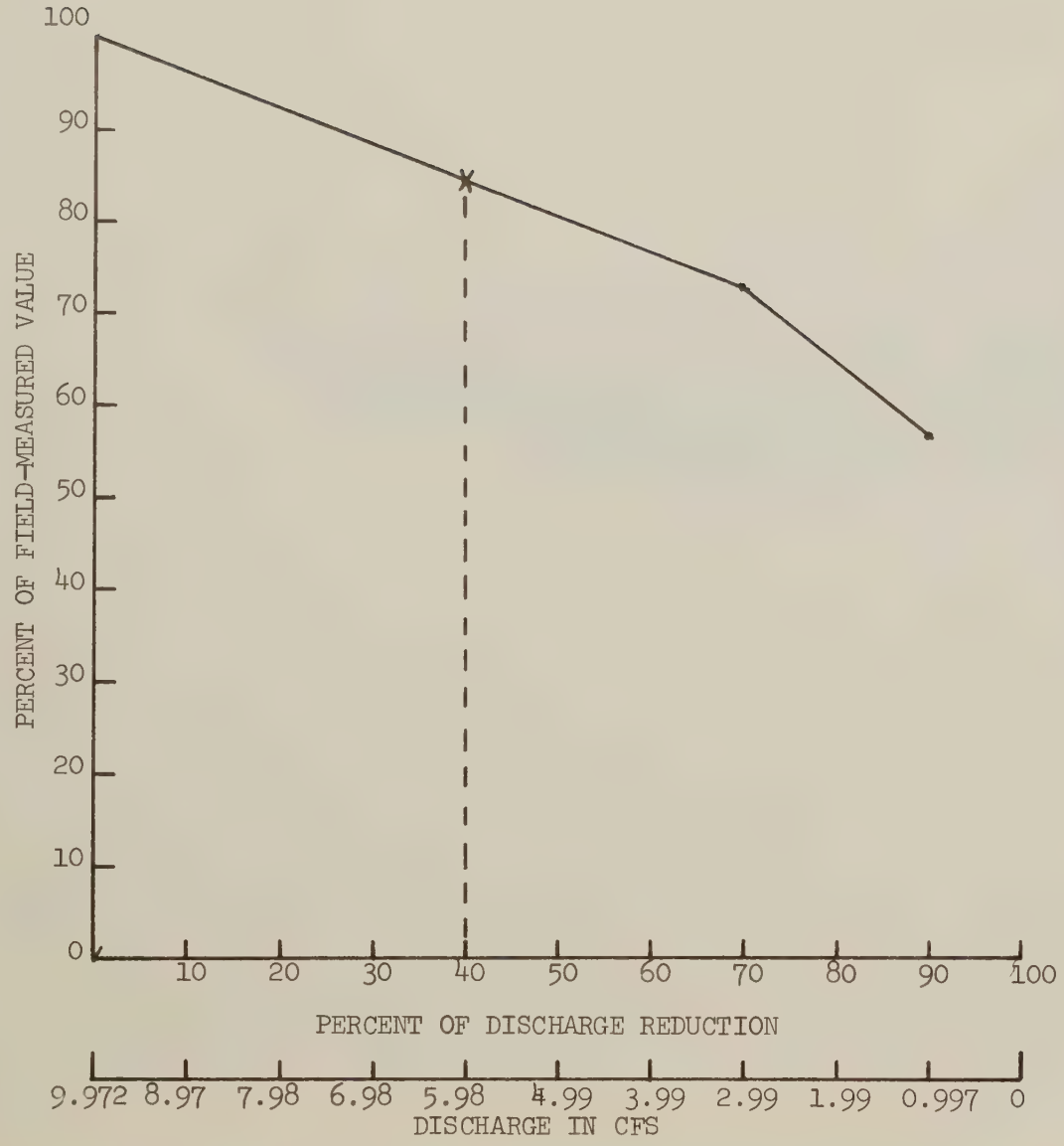
Figure 9
CURRANT CREEK
Station #1 - below dam site -
130 yards below axis

Water Stage	Discharge	%	Velocity	%	Max. Depth	%	Ave. Depth	%	Area	%	Water Surface	%	Wetted Perimeter	%	Habitat Retained	%
0	5.021 cfs	100	0.41 fps	100	1.2 ft	100	0.8 ft	100	12.12 sqft	100	13.7 ft	100	14.1 ft	100	70% opt	100
1	2.992 cfs	60	0.34 fps	83	1.0 ft	83	0.6 ft	75	8.80 sqft	79	13.3 ft	97	13.6 ft	96	62% opt	89
2	2.112 cfs	42	0.30 fps	73	0.8 ft	67	0.4 ft	50	7.04 sqft	58	12.8 ft	93	13.0 ft	92	55% opt	78
3	0.772 cfs	15	0.21 fps	51	0.6 ft	50	0.3 ft	38	3.44 sqft	28	10.5 ft	77	10.6 ft	75	44% opt	63

Station 2, Currant Creek

A 40 percent reduction in the base flow 10 cfs to 6 cfs should retain habitat values at 84 percent of the field-measured characteristics at this station. The habitat-discharge trend relationship curve is shown in Figure 10. Habitat losses of depth, area, and streambottom features at three water stage reductions from the base flow of about 10 cfs is shown in Figure 11.

Stream measurements at Station 2 indicate a gain in discharge below Station 1. A release of 3 cfs in addition to a downstream gain in flow from Layout Creek should meet habitat requirements for a flow of 5 cfs at Station 2. However, the gain in discharge at Station 2 is attributed to the flow from Layout Creek. This flow is diverted by the Layout Diversion Dam. Consquently, a release of 5 cfs is required below the Currant Creek Dam.



100% of Field-Measured Values	
Water Surface	16.5 ft
Wetted Perimeter	16.8 ft
Maximum Depth	1.3 ft
Average Depth	0.8 ft
Discharge	9.972 cfs
Velocity	0.70 fps
Habitat	33% optimum

△ USGS 9-2880

Historical Flow Records

Minimum 3.6 cfs 8/9/61

Maximum 1.26 cfs 5/4/52

Average 46.7 cfs

Diversion Currant Creek Feeder Canal constructed 1936 by the Bureau of Reclamation

Figure 10
CURRANT CREEK
Station #2 - above Forest boundary and 121 feet above fence

Scale:
Horizontal 1" = 2 ft
Vertical 1" = 1 ft

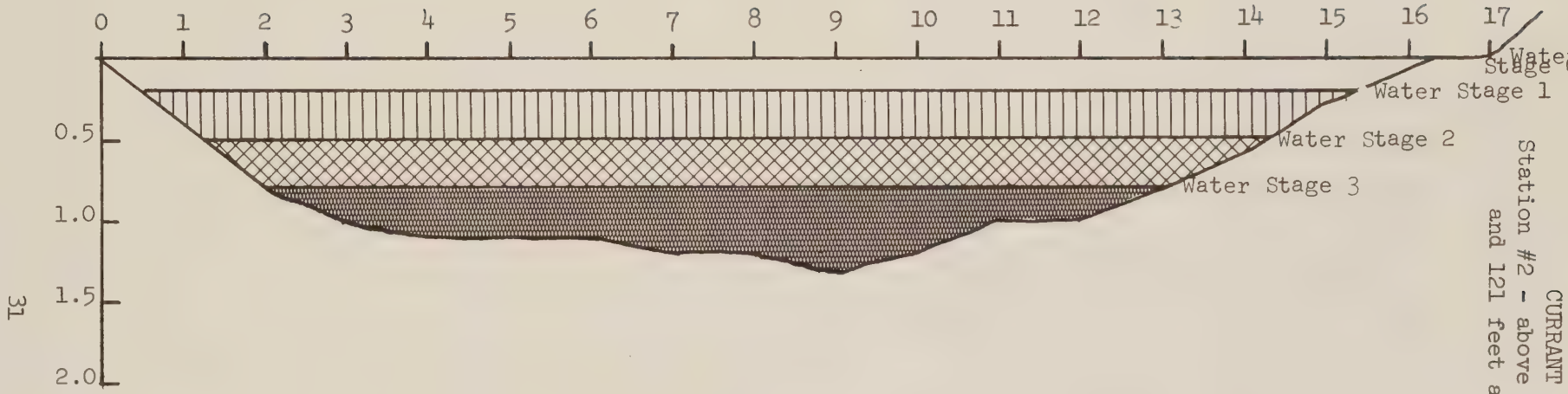


Figure 11
CURRANT CREEK
Station #2 - above Forest boundary
and 121 feet above fence

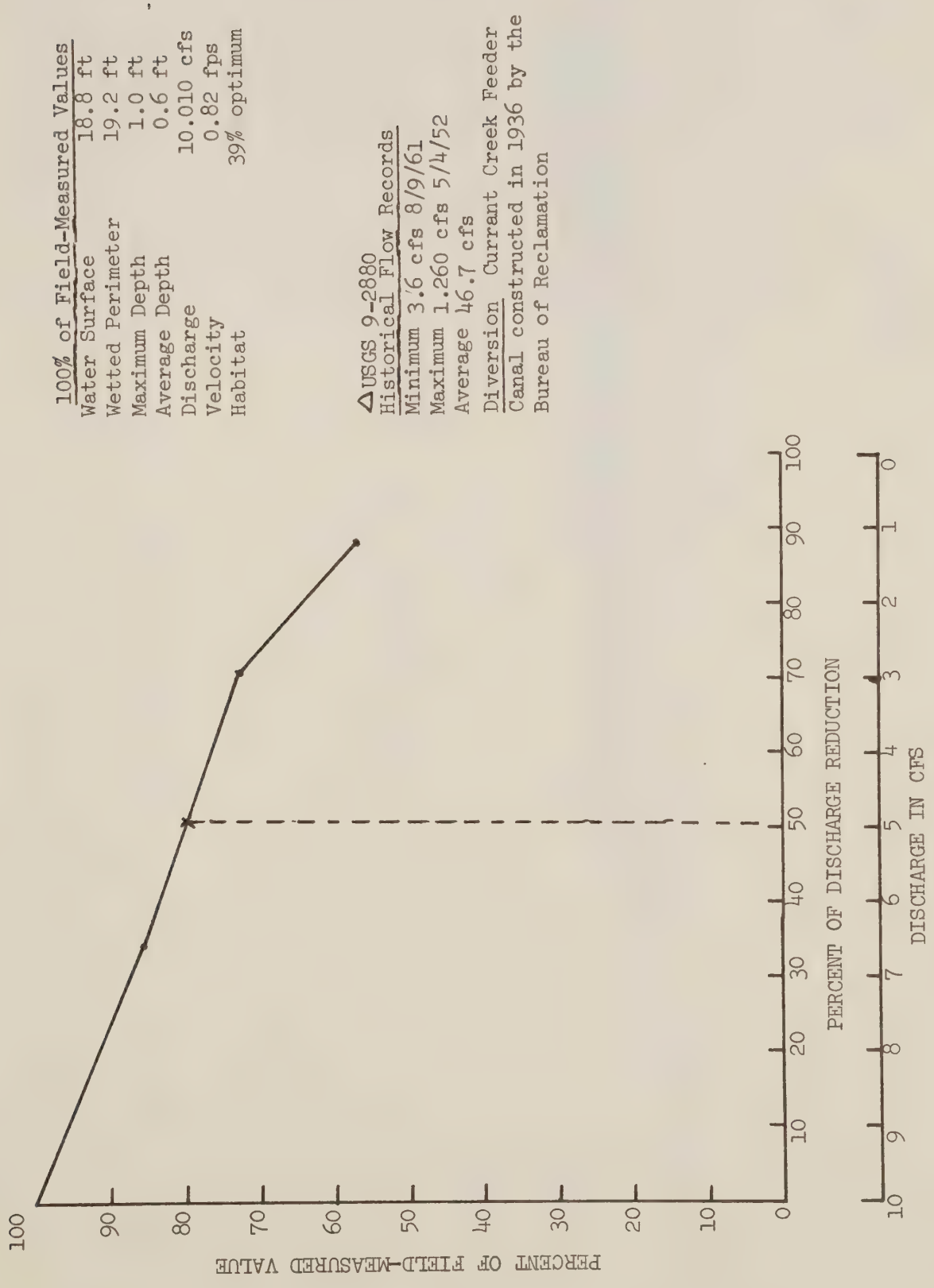
Water Stage	Discharge	%	Velocity	%	Max. Depth	%	Ave. Depth	%	Area	%	Water Surface	%	Wetted Perimeter	%	Habitat Retained	%
0	9.972 cfs	100	0.70 fps	100	1.3 ft	100	0.8 ft	100	14.29 sqft	100	16.5 ft	100	16.8 ft	100	33% opt	100
1	7.207 cfs	72	0.64 fps	91	1.1 ft	85	0.7 ft	88	11.44 sqft	80	14.6 ft	88	15.4 ft	92	29% opt	89
2	3,033 cfs	30	0.48 fps	69	0.8 ft	62	0.5 ft	63	6.32 sqft	44	12.8 ft	78	13.1 ft	78	24% opt	73
3	0.960 cfs	10	0.32 fps	46	0.5 ft	38	0.3 ft	38	3.00 sqft	21	11.1 ft	67	11.2 ft	67	19% opt	57

Station 3, Currant Creek

A 50 percent reduction in the base flow of 10 cfs to 5 cfs should retain 80 percent of the field-measured characteristics at this station. A further reduction in discharge below the 80 percent retention level would be detrimental. The relationship of the habitat-discharge trend curve is shown in Figure 12. Habitat losses of depth, area, and streambottom features at three water stage reductions from the base flow of 10 cfs is shown in Figure 13.

Discharge gains between Stations 2 and 3 are very slight. Habitat requirements of 5 cfs would be sustained with the release of 5 cfs from Currant Creek Dam.

Figure 12
CURRANT CREEK
Station #3 - 203.5 feet above confluence with Red Creek



Scale:
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Vertical 1" = 1 ft

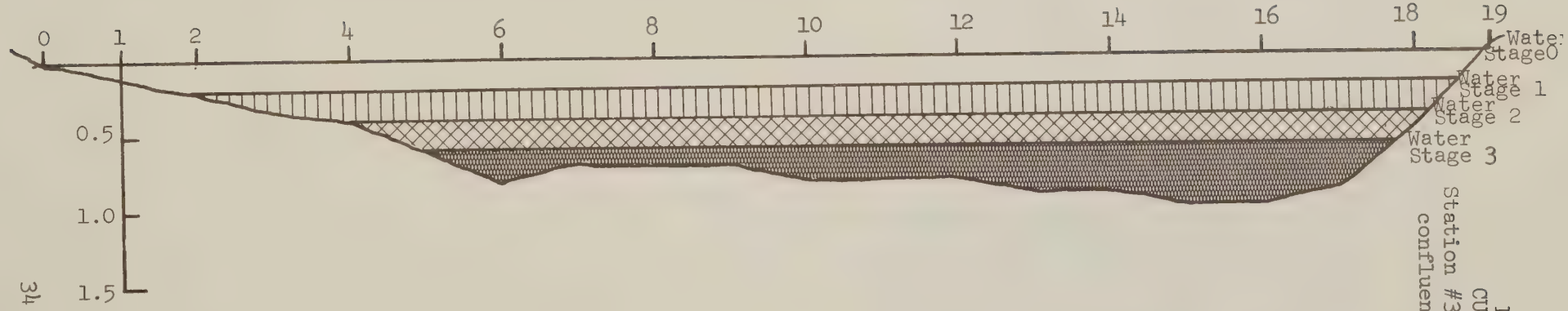

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Figure 13
CURRANT CREEK
Station #3 - 203.5 feet above confluence with Red Creek

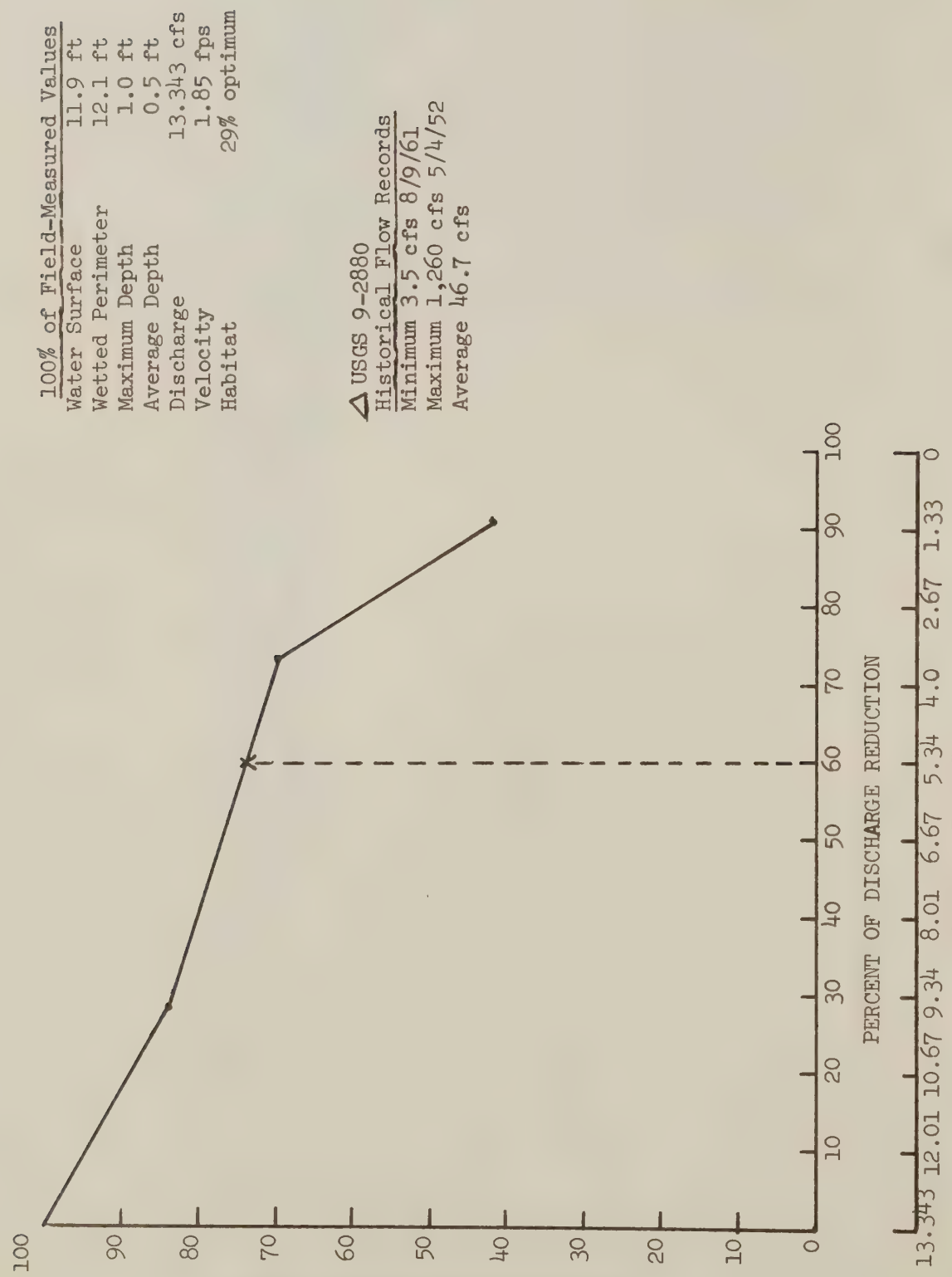
Water Stage	Discharge	%	Velocity	%	Max. Depth	%	Ave. Depth	%	Area	%	Water Surface	%	Wetted Perimeter	%	Habitat Retained	%
0	10.010 cfs	100	0.82 fps	100	1.0 ft	100	0.6 ft	100	12.08 sqft	100	18.8 ft	100	19.2 ft	100	39% opt	100
1	6.570 cfs	66	0.73 fps	89	0.8 ft	80	0.5 ft	83	9.00 sqft	75	16.3 ft	87	17.0 ft	89	34% opt	86
2	2.867 cfs	29	0.56 fps	68	0.6 ft	60	0.4 ft	67	5.12 sqft	42	14.2 ft	76	14.4 ft	75	28% opt	73
3	1.169 cfs	12	0.43 fps	53	0.4 ft	40	0.2 ft	33	2.72 sqft	23	12.7 ft	68	13.3 ft	69	22% opt	57

Station 4, Currant Creek

To retain 80 percent of the field-measured characteristics at this station requires a flow of 8 cfs measured from a base discharge of about 13 cfs. The habitat-discharge trend curve depicts habitat losses drop sharply below a discharge of 4 cfs in Figure 14. A flow of 5 cfs at this point would retain about 74 percent of the field-measured characteristics. This is below the normal objective of 80 percent habitat retention. However, flow measurements at this station are consistently higher than at Stations 1 and 3 for the same period of time. Natural accretions of about 3 cfs between Stations 3 and 4 should be adequate to sustain the habitat at or near the 80 percent retention level.

Stream features at three reduced water stages from the base measured flow of 13 cfs are shown in Figure 15.

Figure 14
CURRANT CREEK
Station #4 - above Upper Meadow above Water Hollow



Scale:
Horizontal 1" = 2 ft
Vertical 1" = 1 ft

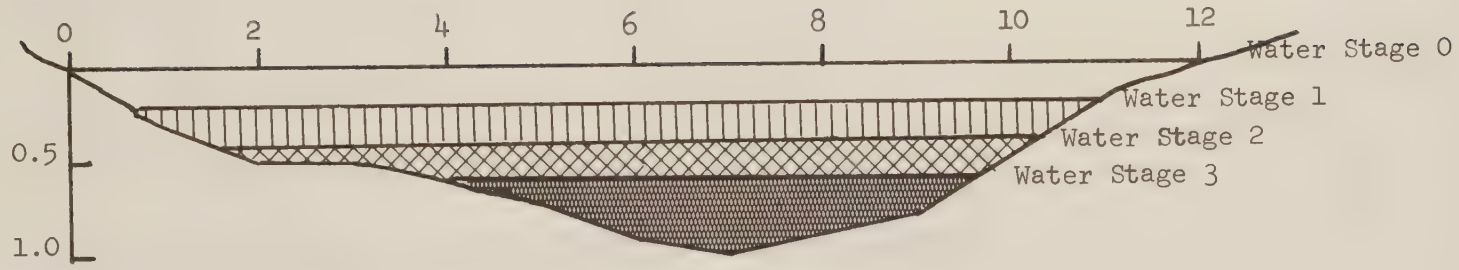


Figure 15
CURRANT CREEK
Station #4 - above Upper Meadow above Water Hollow

Water Stage	Discharge	%	Velocity	%	Max. Depth	%	Ave. Depth	%	Area	%	Water Surface	%	Wetted Perimeter	%	Habitat Retained	%
0	13.343 cfs	100	1.85 fps	100	1.0 ft	100	0.5 ft	100	7.21 sqft	100	11.9 ft	100	12.1 ft	100	29% opt	100
1	9.609 cfs	72	1.82 fps	98	0.8 ft	80	0.4 ft	80	5.28 sqft	73	10.2 ft	86	10.4 ft	86	24% opt	84
2	3.612 cfs	27	1.29 fps	70	0.6 ft	60	0.3 ft	60	2.80 sqft	39	8.8 ft	74	9.2 ft	76	20% opt	70
3	1.164 cfs	9	0.97 fps	52	0.4 ft	40	0.2 ft	40	1.20 sqft	17	5.0 ft	42	5.4 ft	45	12% opt	42

A comparison of the average historic high, low, and mean monthly discharge flows in relation to the recommended release of 5 cfs in Currant Creek is shown for USGS gage 9-2870 below Red Ledge Hollow and gage 9-2880 near Fruitland, Figures 16 and 17.

The duration flow curve for USGS gage 9-2880 at Fruitland covers the period from 1936-1957. A flow of 5 cfs as indicated in Figure 18 would normally be expected 100 percent of the time. An existing feeder-canal--Co-op Creek Canal--diverts part of the headwaters of Currant Creek into the Strawberry Reservoir. The canal was constructed by the Bureau of Reclamation in 1936.

Figure 16
CURRANT CREEK BELOW RED LEDGE HOLLOW NEAR FRUITLAND
U.S.G.S. 9-2870
1946-1968 23 years record
--- High 688 cfs 5/2/52
Low 0.7 cfs 9/8/59
•••• Ave. 25 cfs

MEAN MONTHLY FLOWS

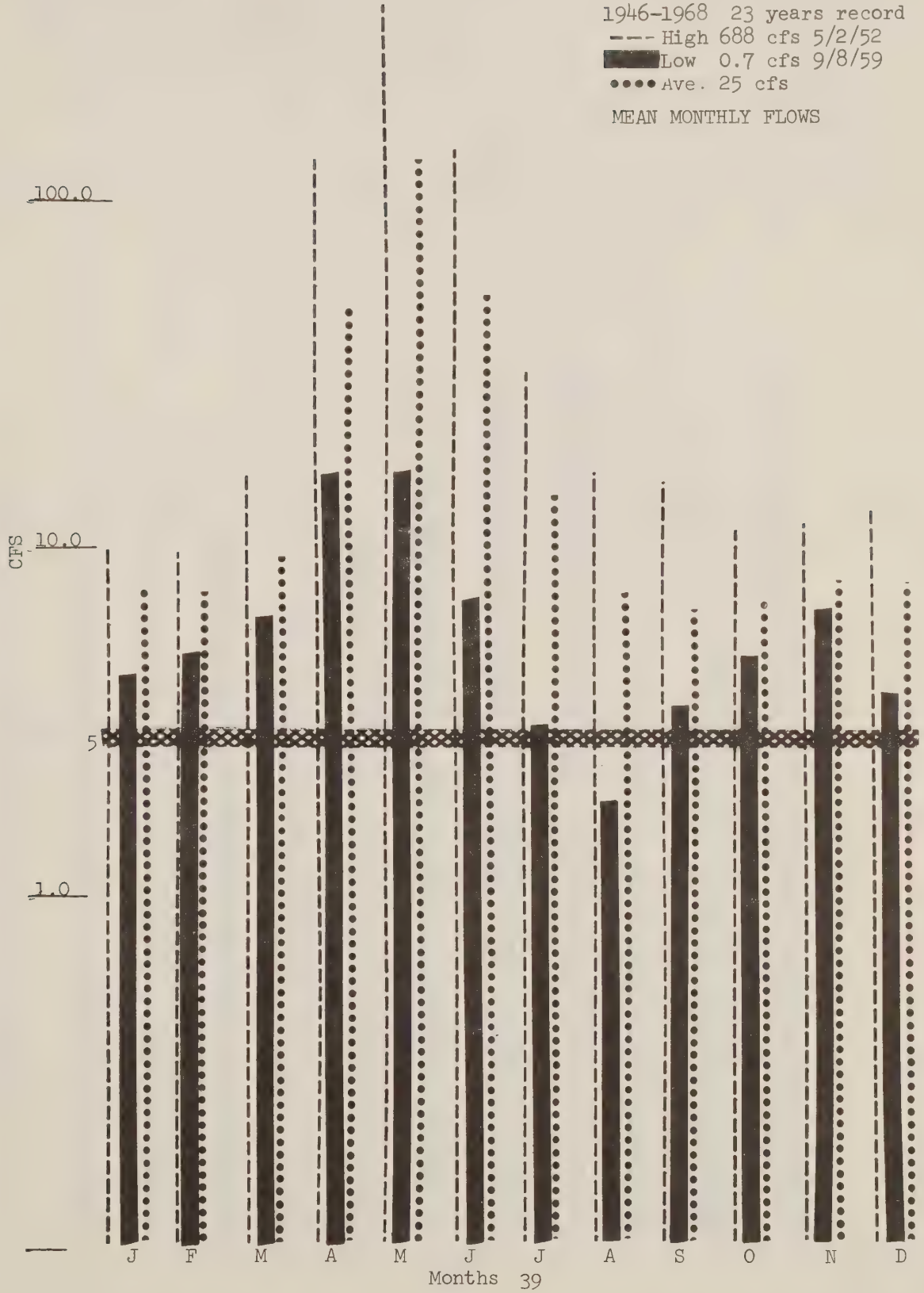
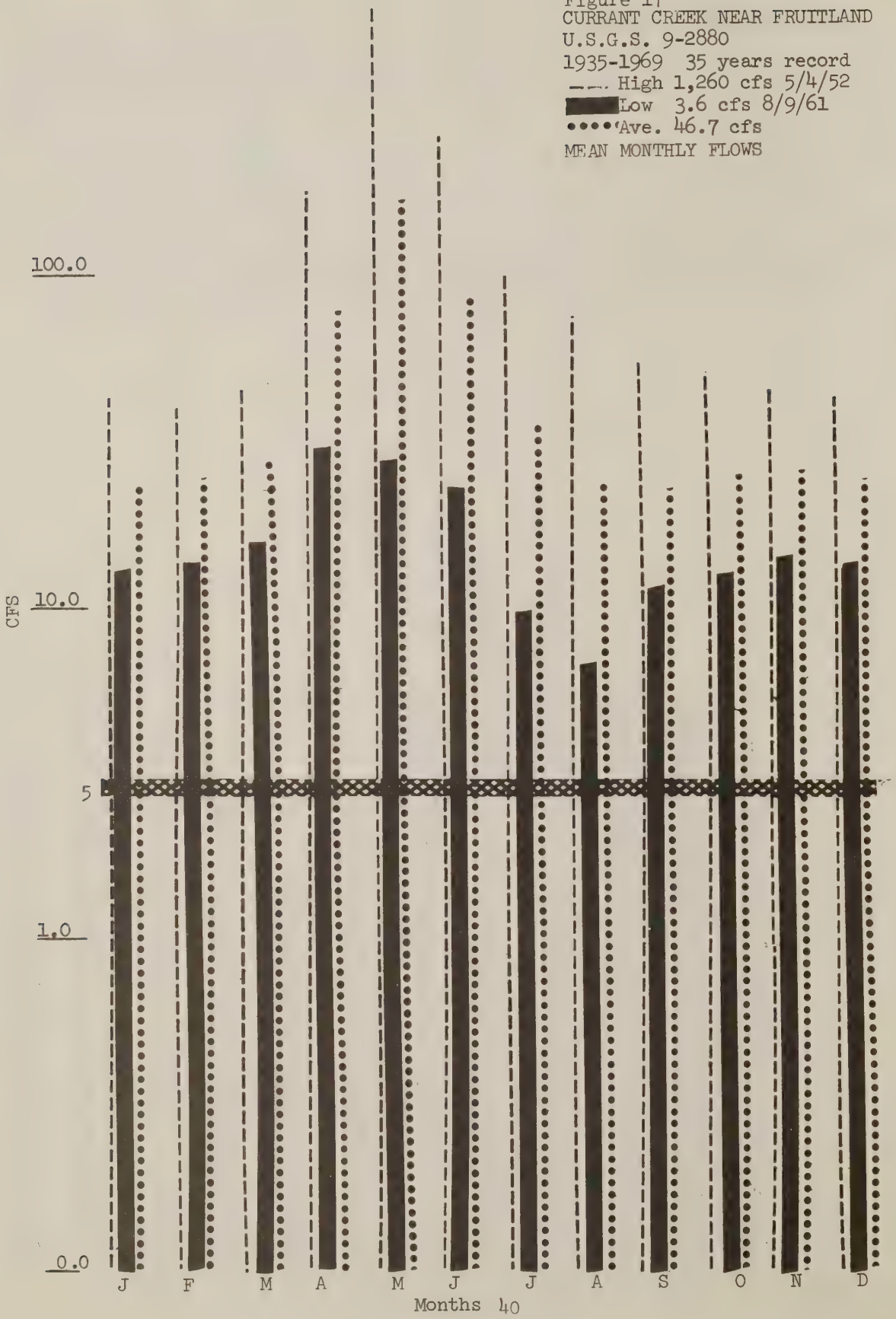


Figure 17
CURRANT CREEK NEAR FRUITLAND
U.S.G.S. 9-2880
1935-1969 35 years record
—— High 1,260 cfs 5/4/52
Low 3.6 cfs 8/9/61
•••• Ave. 46.7 cfs
MEAN MONTHLY FLOWS



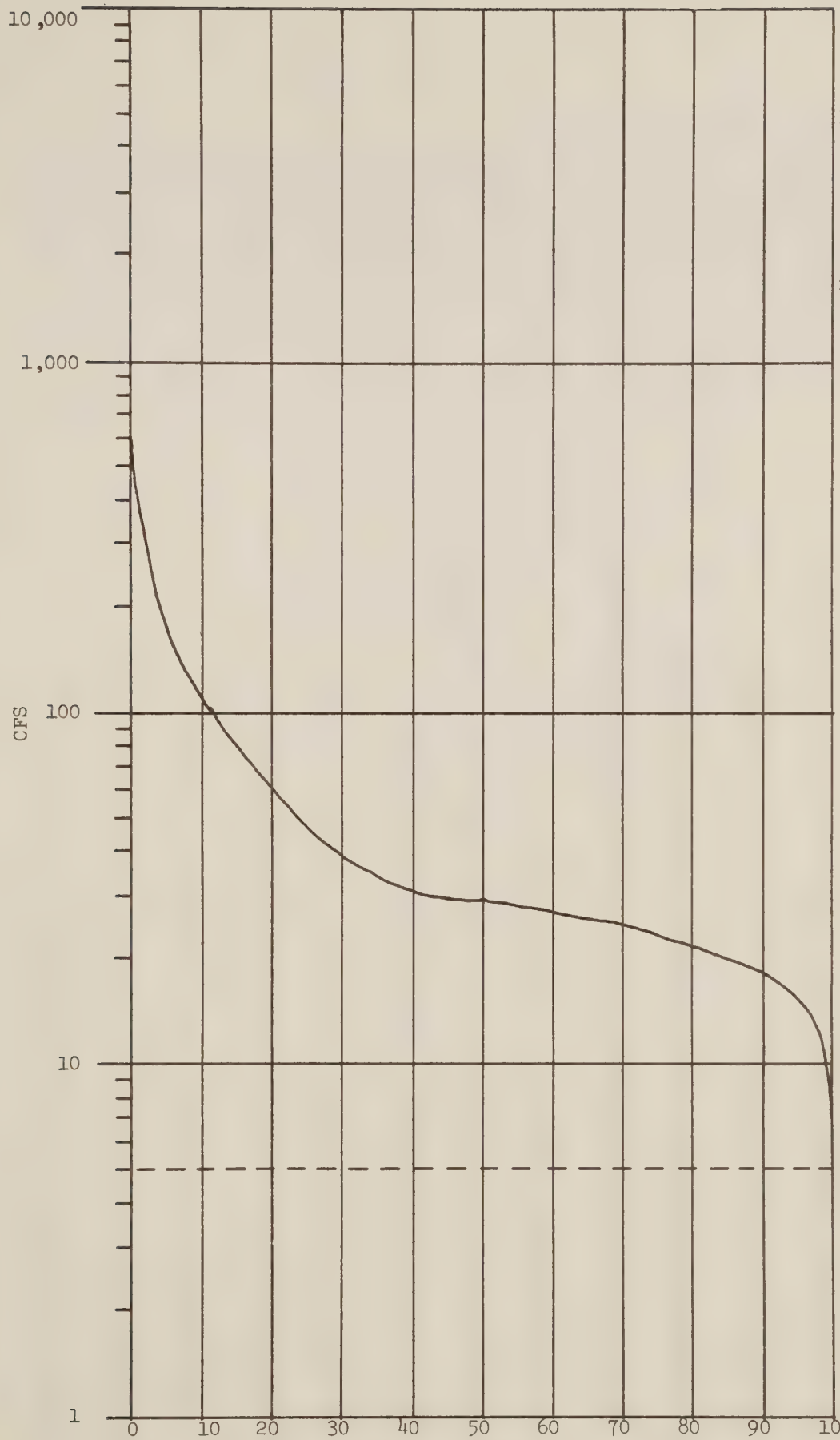


Figure 18

Station No. 2880

Currant Creek near Fruitland, Utah, 1936-57, not adjusted.

Daily discharge in cfs that was equaled or exceeded for indicated percentage of time.

West Fork of Duchesne River

There were no additional streamflow habitat studies made on the West Fork of Duchesne River upon completion of the initial survey in 1962 by the Forest Service. A minimum sustained release of not less than 8 cfs, at the Vat Diversion Dam, was recommended at that time. The proposed release of 8 cfs, based on that data, is assumed to be still a valid recommendation.

Hades Creek

A diversion dam to be constructed on Hades Creek would completely dewater approximately 1.5 miles of stream within the Forest boundary. The stream is relatively small and has a Class III fishing water rating. No further streamflow habitat studies were conducted after the initial survey of the stream in 1962. The preliminary Forest Service report of 1964 contained a recommendation for a minimum continuous release of 3 cfs at the Hades Creek Diversion Dam. The proposed recommendation of 3 cfs in this short stream was retracted based on a present diversion of the stream for irrigation and occasional intermittent flows.

Wolf Creek

A proposed recommendation of 3 cfs for release through the Rhodes Diversion Dam on Wolf Creek was contained in the preliminary Forest Service report of 1964. There were no additional habitat-discharge studies made after the initial survey in 1962.

Wolf Creek is a small stream about 3.5 miles in length and has a Class III fishing water rating. Approximately 1.25 miles of Wolf Creek would be affected by this diversion. The proposed release recommendation of 3 cfs to sustain the aquatic habitat is assumed to be valid.

Twin Creek

Twin Creek is a small tributary to Wolf Creek and does not sustain suitable aquatic habitat for a fishery because of intermittent flows and dry channel. No recommendation has been or is being considered for this stream which is not listed in the classification of Utah fishing waters.

The Win Diversion Dam will be constructed on Twin Creek.

Sixth Water

There were no additional studies conducted on Sixth Water after completion of the initial 1962 survey. The present normal flow in Sixth Water is currently regulated by releases from Strawberry Reservoir through the existing Strawberry irrigation tunnel. This tunnel will be abandoned upon construction of the Syar Tunnel from Strawberry Reservoir through the Great Basin Divide. The flow into Sixth Water will then consist of seepage and natural flows from the tunnel exit and downstream accretion flows. This flow is estimated to vary from 8 to 12 cfs and should be adequate to sustain the aquatic habitat to that point on the stream. Releases from the Sixth Water Reservoir for downstream fisheries are to be equal to the natural inflow of the stream above the proposed dam.

Sixth Water is rated as a Class III fishing stream which places it in the majority of Utah's waters. Developments on this class of water should be planned to minimize any fishery or aquatic habitat losses. Under project operations the Sixth Water channel will be subject to enhancement because the existing high irrigation release flows will be diverted into the Syar Tunnel. The presently scoured channel and unstable banks will be improved through a rehabilitation program.

Diamond Fork

No additional studies were conducted on Diamond Fork after the initial 1962 survey. Downstream flows below the Dyne Powerplant will result in habitat losses unless maximum releases are regulated to prevent degradation of the stream channel. Maximum release should not exceed 300 cfs.

The twice daily surge from the Dyne Powerplant will release 600 cfs of which 400 cfs will be diverted into the Diamond Fork Creek channel to Hayes Reservoir and 200 cfs diverted into the Wasatch Aqueduct. The maximum flow in Diamond Fork Creek between Dyne Powerplant and Hayes Reservoir should not exceed 300 cfs. An alternate method to convey the excess flow above the channel carrying capacity to Hayes Reservoir will be necessary to prevent extensive streambank and channel degradation.

Diamond Fork is rated as a Class III fishing stream. Consequently, developments should be planned to minimize aquatic habitat and fishery losses. However, the excessive channel releases below the Dyne Powerplant will eliminate the fishing in this section of stream and scour the channel. The twice daily surges also present a safety problem with respect to visitors in the canyon.

Water Hollow

No additional studies were conducted on Water Hollow after completion of the initial 1962 Forest Service report. Water Hollow when affected by the project is not located within the Forest boundary.

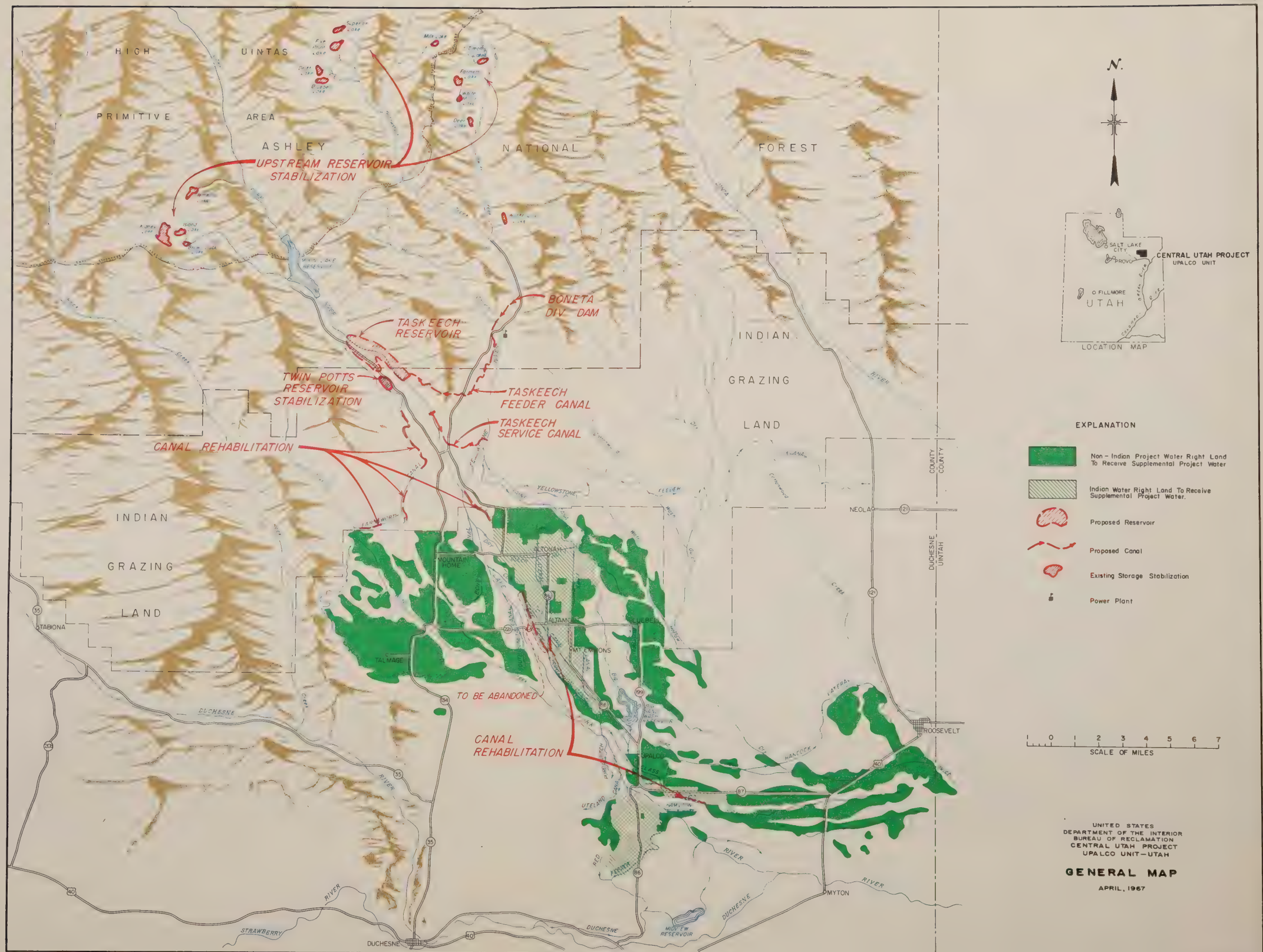
Water Hollow does not support a trout fishery and is rated as Class IV waters. This indicates waters with a Class IV rating are a minor importance to the fishery resource of Utah, primarily due to existing diversions or dewatering.

There are no recommendations proposed for Water Hollow.

Layout Creek

No additional studies were conducted on Layout Creek since 1962. Layout Creek does not support a trout fishery and is not rated in the classification of Utah waters. The proposed diversion point is not within the Forest boundary.

There are no recommendations proposed for Layout Creek.


HIGH
UINTAS
PRIMITIVE
AREA
ASHLEY
NATIONAL
FOREST
UPSTREAM RESERVOIR STABILIZATION
BONETA DIV. DAM
TASKEECH RESERVOIR
TWIN POTTS RESERVOIR STABILIZATION
TASKEECH FEEDER CANAL
TASKEECH SERVICE CANAL
CANAL REHABILITATION
INDIAN
GRAZING
LAND
TO BE ABANDONED
CANAL REHABILITATION
MOUNTAIN HOME
ALTONAH
ALTAMONT
LYMAN
TALMAGE
MYTON
ROOSEVELT
NEOLA
DUCHESNE
TABIONA
MIDVIEW RESERVOIR
DUCHESNE COUNTY
UINTAH COUNTY
N.
SALT LAKE CITY
PROVO
FILLMORE
UTAH
CENTRAL UTAH PROJECT
UPALCO UNIT
LOCATION MAP
EXPLANATION
Non-Indian Project Water Right Land To Receive Supplemental Project Water
Indian Water Right Land To Receive Supplemental Project Water.
Proposed Reservoir
Proposed Canal
Existing Storage Stabilization
Power Plant
0 1 2 3 4 5 6 7
SCALE OF MILES
UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
CENTRAL UTAH PROJECT
UPALCO UNIT—UTAH
GENERAL MAP
APRIL, 1967
987-418-78

The Upalco Unit is located in Duchesne County and was planned to provide supplemental irrigation water for about 43,000 acres of Indian and non-Indian lands along the Lake Fork River.

Taskeech Reservoir on Lake Fork, with a 68,400 acre-foot capacity, will be the major feature of the unit. It will store regulated flows of Lake Fork and Yellowstone Rivers and provide for recreation irrigaion and flood control. Boneta Diversion Dam on Yellowstone River will divert water through an 8.5-mile long Taskeetch feeder canal to Taskeetch Reservoir. Taskeetch Dam will be built on Indian lands; however, over half of the reservoir will be inside the Ashley National Forest boundary. The portion of stream we are concerned with is between the existing Moon Lake Reservoir and Taskeetch, and we will request a minimum flow between these reservoirs. Boneta Diversion Dam diverts water from Yellowstone to Lake Fork. We will request a minimum flow below this diversion dam for the Yellowstone River.

Yellowstone River

Construction of the Boneta Diversion Dam on Yellowstone Creek will affect approximately 2.5 miles of stream within the Forest boundary. The operating plan provides for a release of 25 cfs below the diversion point to maintain the aquatic habitat. The released water will then be stored downstream in the Big Sand Wash Reservoir.

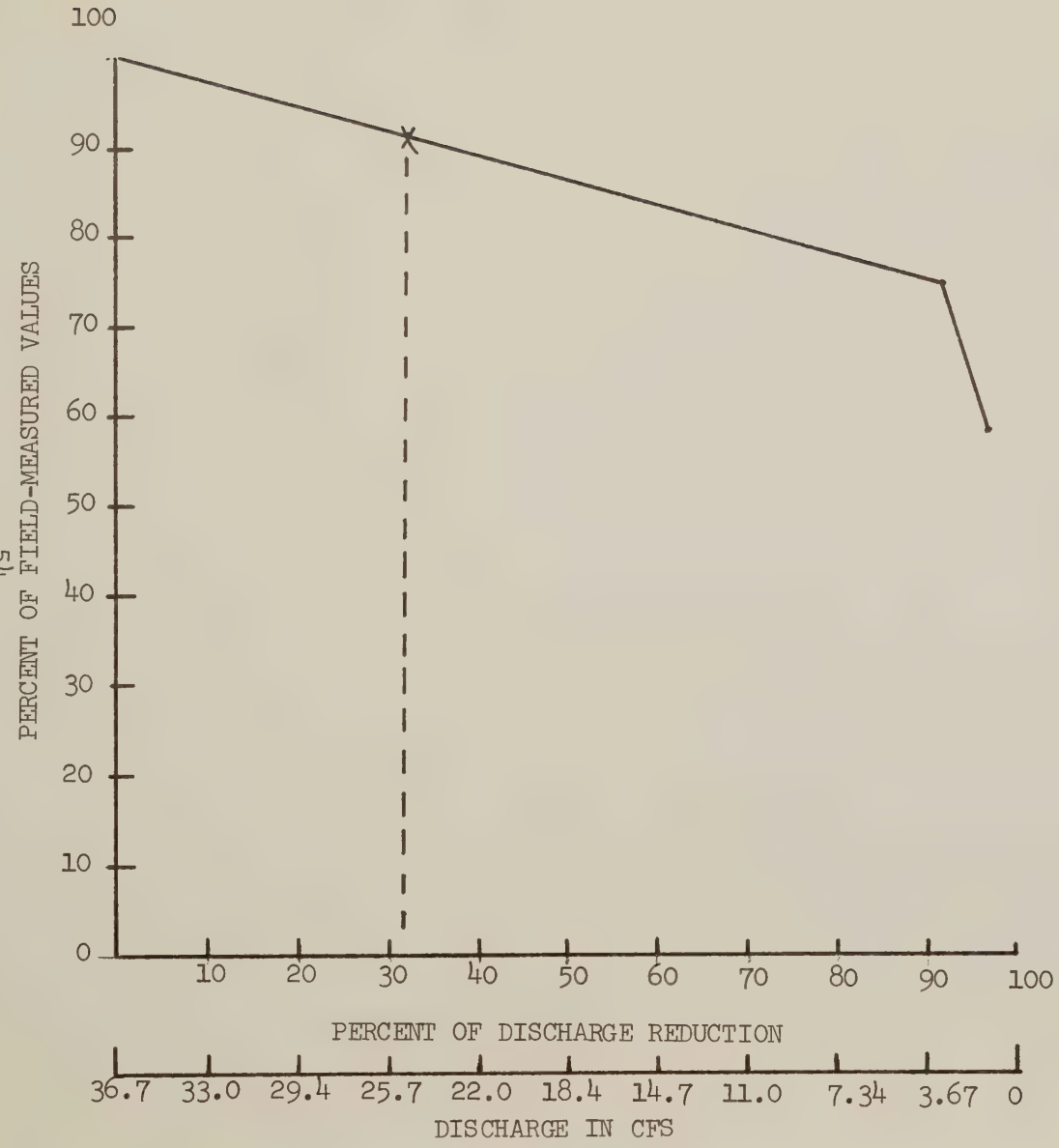
The existing Moon Lake Power diversion on Yellowstone River will be eliminated as part of the Upalco Unit plan. The removal of the powerplant and diversion canal will benefit the downstream fishery through a continuous flow of 25 cfs. Present operation of the powerplant has reduced downstream flows and has occasionally depleted almost the entire flow in approximately a quarter mile of the stream.

Yellowstone River is rated as a Class III stream which indicates there is some natural reproduction of trout. Game fish include cutthroat trout and brook trout. Periodic stocking of rainbow trout catchables supplement the fishery.

A series of five stations were established on Yellowstone River. Stations 2 through 5 are located above the Boneta Diversion. These stations will be associated with diversions related to the Ute Indian Unit and will be covered in that phase of the project. Station 1 is located below the Boneta Diversion.

Station 1, Yellowstone River

The habitat-discharge trend relationship curve (Figure 19) indicates a sustained flow of 25 cfs below the Boneta Diversion should retain about 91 percent of the field-measured characteristics from a base flow of about 37 cfs. The proposed release of 25 cfs below the Boneta diversion point should benefit the downstream fishery because of greater habitat retention. Habitat losses will be minimized as shown in the representative channel cross section Figure 20.



100% of Field-Measured Values	
Water Surface	26.2 ft
Wetted Perimeter	28.3 ft
Maximum Depth	1.4 ft
Average Depth	0.8 ft
Discharge	36.70 cfs
Velocity	1.87 fps
Pools rated 1,2,3	41% sample
Habitat	61% optimum

△ USGS 9-2925
Historical Flow Records
Minimum 26 cfs 2/24/60 freeze
Maximum 1,880 cfs 6/19/49
Average 141 cfs
Diversion Diurnal fluctuation
1.5 miles upstream - powerplant

Figure 19
YELLOWSTONE CREEK
Station #1 - 1/4 mile above Yellowstone Guard Station
Campground and between Yellowstone Ridge Campground

Scale:
Horizontal 1" = 4 ft
Vertical 1" = 1 ft

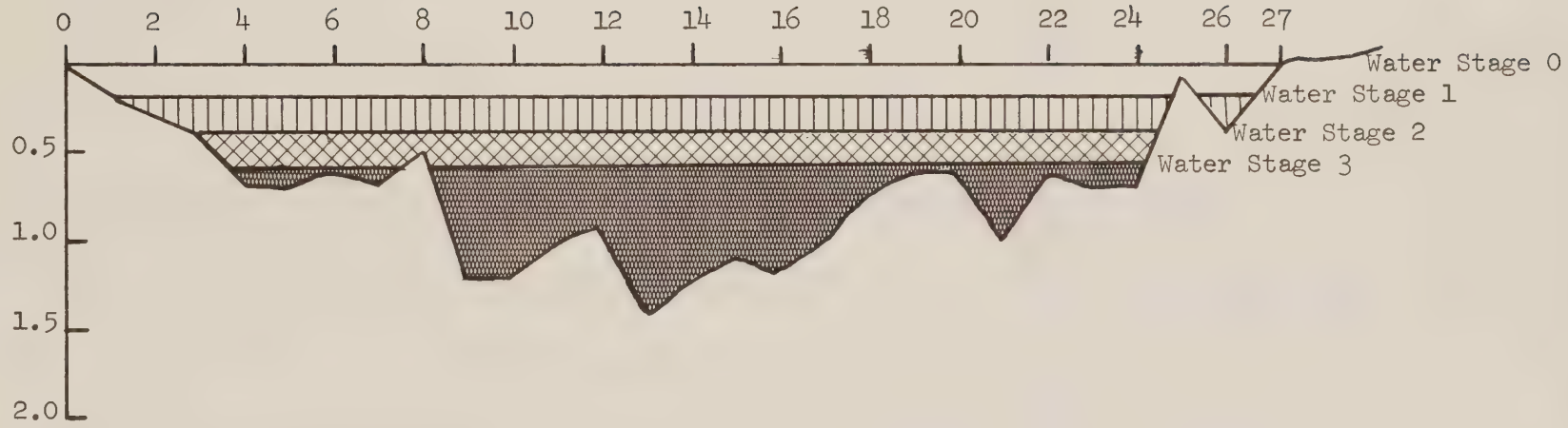


Figure 20
YELLOWSTONE CREEK
Station #1 - 1/4 mile above Yellowstone
Guard Station Campground and between
Yellowstone Ridge Campground

Water Stage	Discharge	%	Velocity	%	Max. Depth	%	Ave. Depth	%	Area	%	Water Surface	%	Wetted Perimeter	%	Habitat Retained	%
0	36.70 cfs	100	1.87 fps	100	1.4 ft	100	0.8 ft	100	19.58 sqft	100	26.2 ft	100	28.3 ft	100	61% opt	100
1	20.65 cfs	56	1.51 fps	81	1.2 ft	86	0.6 ft	75	13.68 sqft	70	24.6 ft	94	26.6 ft	94	54% opt	88
2	2.78 cfs	8	0.28 fps	15	1.0 ft	71	0.5 ft	63	9.92 sqft	51	21.4 ft	82	24.1 ft	85	47% opt	77
3	0.99 cfs	3	0.19 fps	10	0.8 ft	57	0.3 ft	36	5.20 sqft	27	16.9 ft	65	21.9 ft	77	36% opt	59

Comparison of the proposed 25 cfs release with the historical average high, low, and mean monthly flows for USGS gage 9-2925 is illustrated in Figure 21. The gage is located approximately 0.5 mile below the Forest boundary.

The flow duration curve (Figure 22) also indicates a flow of 25 cfs would normally be attained 100 percent of the time.

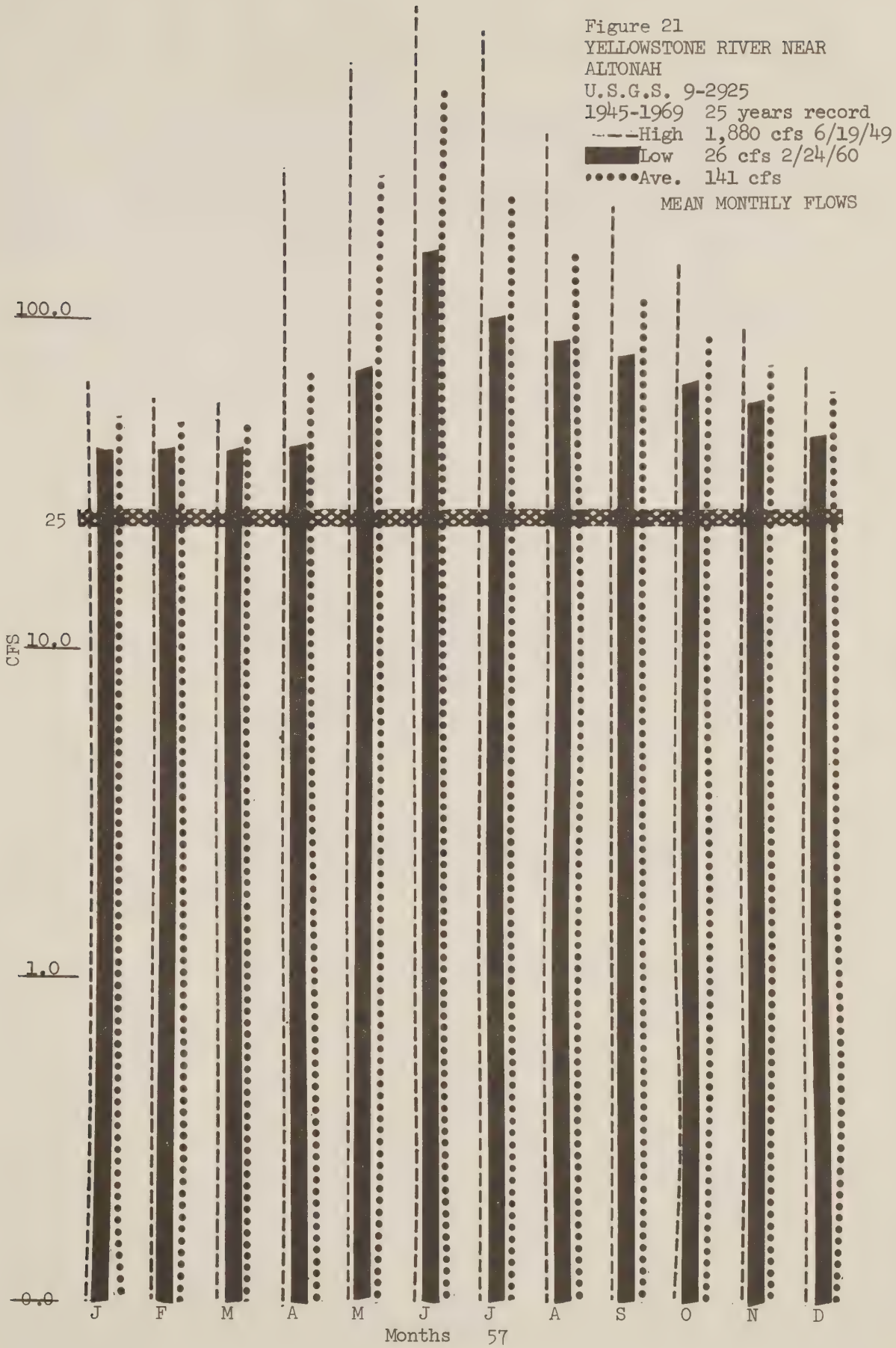


Figure 21
YELLOWSTONE RIVER NEAR
ALTONAH
U.S.G.S. 9-2925
1945-1969 25 years record
High 1,880 cfs 6/19/49
Low 26 cfs 2/24/60
Ave. 141 cfs
MEAN MONTHLY FLOWS
100.0
25
10.0
1.0
0.0
CFS
J
F
M
A
M
J
J
A
S
O
N
D
Months

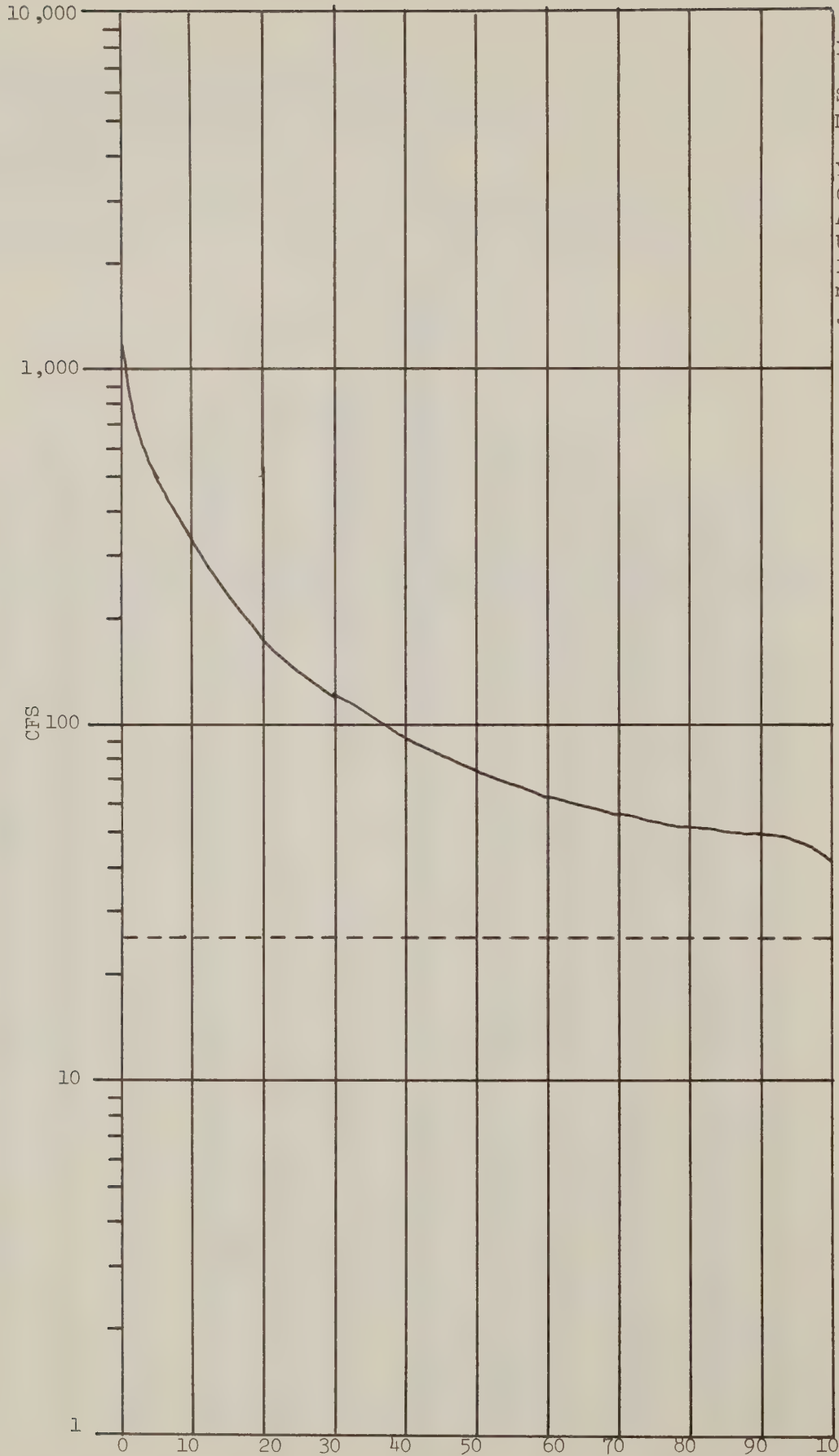


Figure 22

Station No. 2925

Yellowstone Creek near Altonah, Utah, 1945-57, not adjusted.

Daily discharge in cfs that was equaled or exceeded for indicated percentage of time.

Lake Fork River

The flows in Lake Fork River are presently regulated by Moon Lake Reservoir. During the non-irrigation season, there is no flow in the channel for a stretch of about 3 miles because the flow is diverted for storage. Fish inhabiting this section during the irrigation season are believed to escape from the reservoir and are lost when the stream is dewatered in the fall.

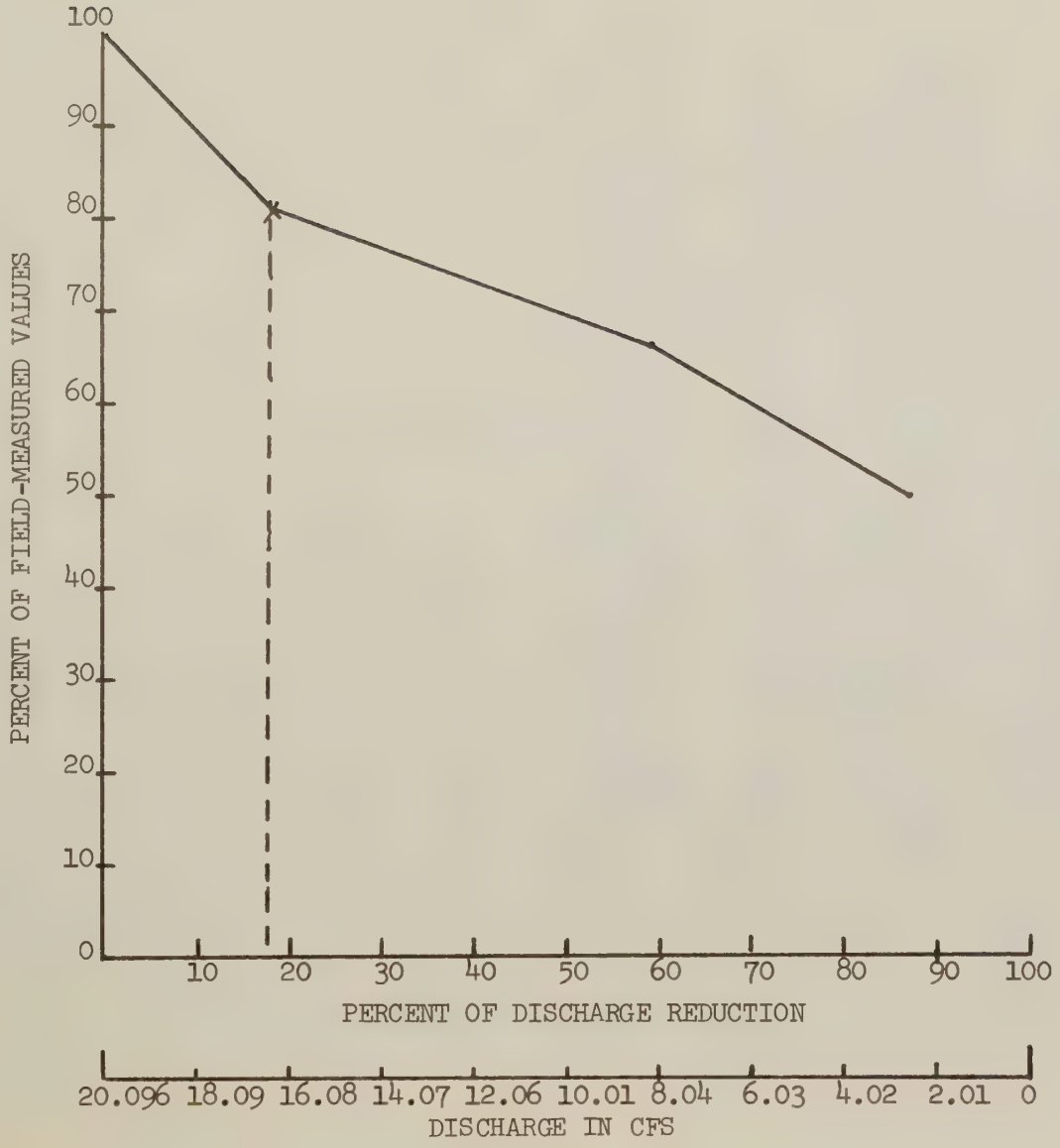
A series of springs below this 3-mile stretch produce a flow sufficient to sustain a natural population of brown, cutthroat, and brook trout. Periodic stocking of rainbow trout supplement the fishery. Taskeech Reservoir will be constructed below Moon Lake Reservoir and inundate an existing productive portion of the stream resulting in loss of lotic aquatic habitat.

Releases from Moon Lake Reservoir which would flow into Taskeech Reservoir would partly compensate for aquatic habitat losses. The fisheries in Lake Fork between the two reservoirs would be substantially improved by an adequate flow release.

A study station was established on Lake Fork River just above the Forest boundary. The habitat-discharge trend relationship as shown in Figure 23 shows a rapid loss of habitat features when the base measured flow of 20 cfs is reduced to 17 cfs.

A sustained release of 17 cfs from Moon Lake Reservoir would improve the habitat and fishery potential in Lake Fork between the two reservoirs.

The recomended release of 17 cfs can be compared with the stream-bottom habitat features in the cross section view shown in Figure 24 and the historical average monthly flows for USGS gage 9-2910 shown in Figure 25.



100% of Field-Measured Values	
Water Surface	29.8 ft
Wetted Perimeter	29.8 ft
Maximum depth	1.5 ft
Average depth	0.7 ft
Discharge	20.096 cfs
Velocity	1.111 fps
Habitat	55% optimum

△ USGS 9-2910
Historical Flow Records
Minimum No flow regulated
Maximum 2,180 cfs 6/19/49
Average 129 cfs
Diverion Moon Lake Reservoir regulates flow.

Figure 23
LAKE FORK RIVER
Station #1 - 150 feet above Forest boundary

Scale:
Horizontal 1" = 5 ft
Vertical 1" = 1 ft

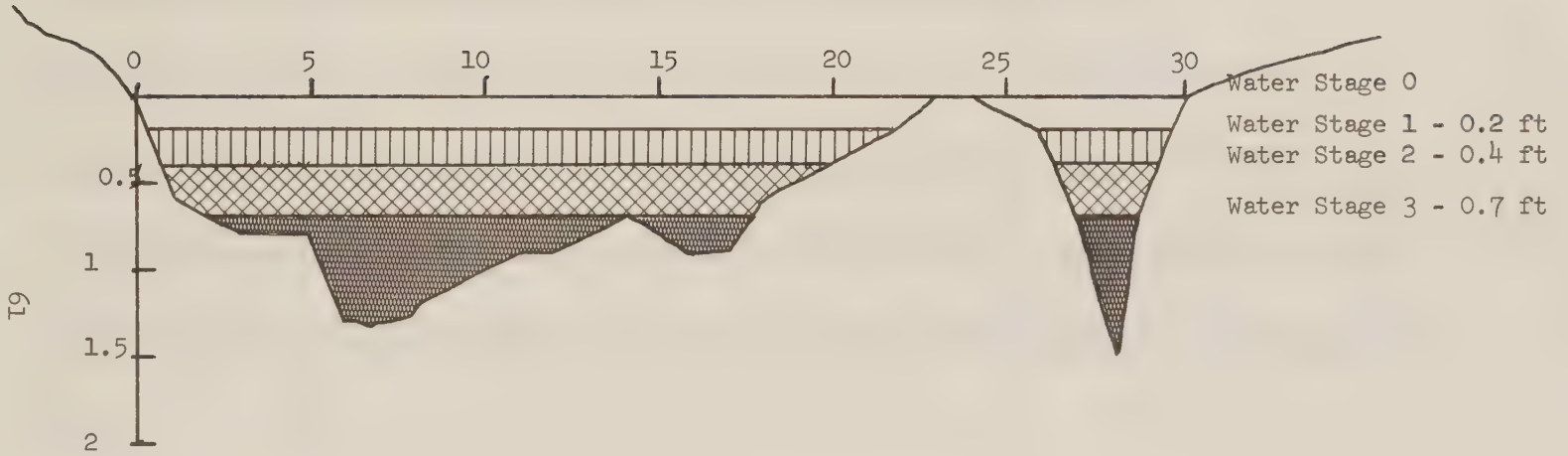
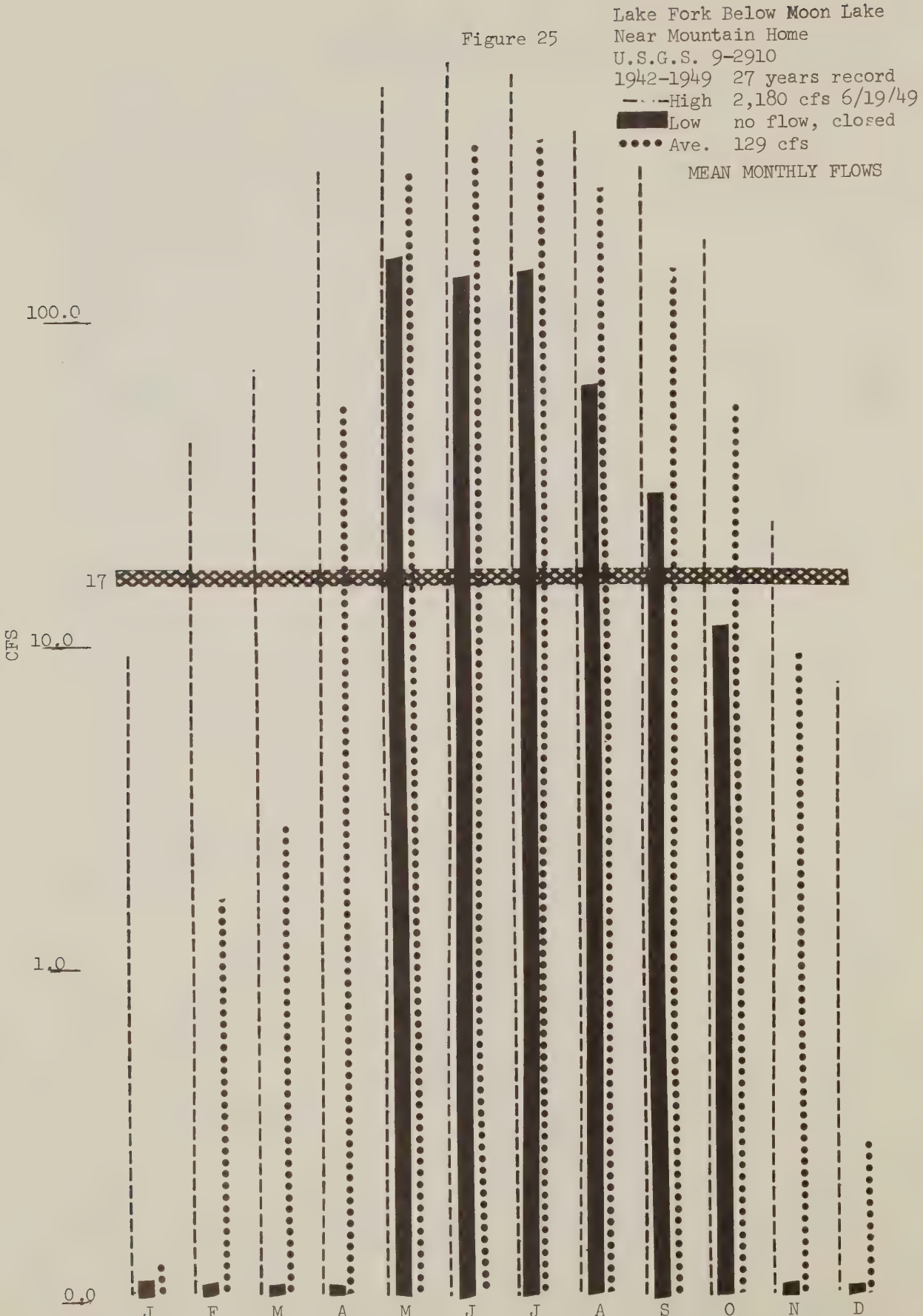


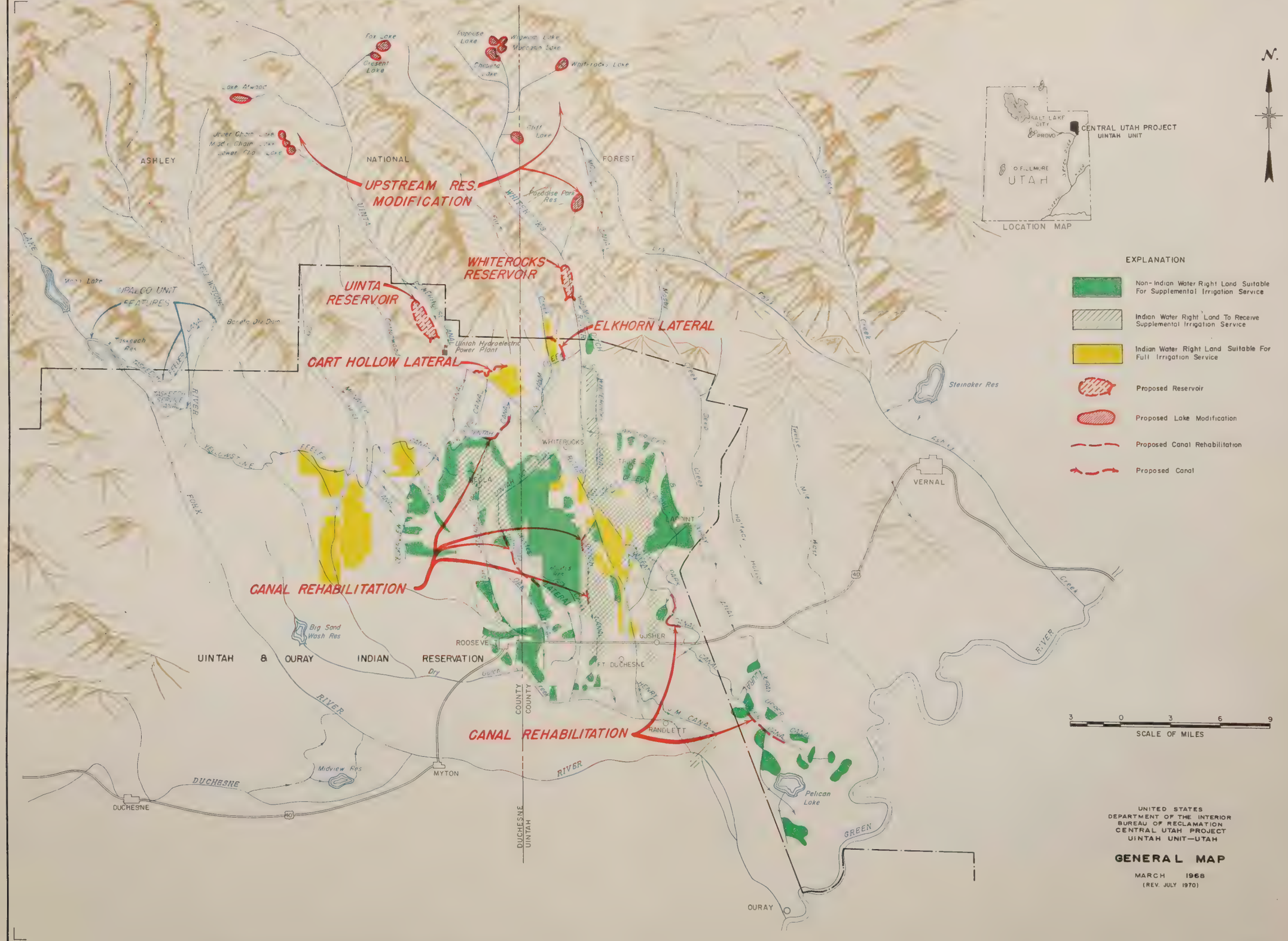
Figure 24
LAKE FORK RIVER
Station #1 - 150 feet above Forest boundary

Water Stage	Discharge	%	Velocity	%	Max. Depth	%	Ave. Depth	%	Area	%	Water Surface	%	Wetted Perimeter	%	Habitat Retained	%
0	20.096 cfs	100	1.11 fps	100	1.5 ft	100	0.7 ft	100	18.14 sqft	100	29.8 ft	100	29.8 ft	100	55% opt	100
1	16.545 cfs	82	1.08 fps	97	1.3 ft	87	0.5 ft	71	15.32 sqft	84	24.5 ft	82	26.8 ft	90	44% opt	81
2	8.324 cfs	41	0.86 fps	77	1.1 ft	73	0.3 ft	43	9.68 sqft	53	22.1 ft	74	24.1 ft	81	26% opt	66
3	2.688 cfs	13	0.66 fps	54	0.8 ft	53	0.2 ft	29	4.48 sqft	25	17.1 ft	57	19.5 ft	65	28% opt	50

Figure 25


Lake Fork Below Moon Lake
Near Mountain Home
U.S.G.S. 9-2910
1942-1949 27 years record
High 2,180 cfs 6/19/49
Low no flow, closed
Ave. 129 cfs
MEAN MONTHLY FLOWS
100.0
17
10.0
1.0
0.0
CFS
J
F
M
A
M
J
J
A
S
O
N
D

UINTAH UNIT


UPSTREAM RES. MODIFICATION
WHITEROCKS RESERVOIR
UINTA RESERVOIR
ELKHORN LATERAL
CART HOLLOW LATERAL
CANAL REHABILITATION
CANAL REHABILITATION
UPALCO UNIT FEATURES
ASHLEY NATIONAL FOREST
UINTAH & OURAY INDIAN RESERVATION
Fox Lake
Crescent Lake
Porpoise Lake
Chepeta Lake
Wagwam Lake
Mucogan Lake
Whiterocks Lake
Lake Atwood
Jewer Chain Lake
Major Chair Lake
Lower Chain Lake
Cliff Lake
Paradise Park Res
Moon Lake
Big Sand Wash Res
Midview Res
Pelican Lake
Steinaker Res
Uintah Hydroelectric Power Plant
Boreto Div. Dam
Tabeaud Res
Ashley Creek Storage Res
WHITEROCKS
MYTON
ROOSEVELT
GUSHER
FT DUCHESNE
RANDLETT
LAPOINT
VERNAL
DUCHESNE
OURAY
Big Sand Wash Res
Uintah River
Yellowstone River
Duchesne River
Green River
Dry Gulch
Whiterocks River
Ashley Creek
Deep Creek
Hatch Creek
Hades Hollow
Fourmile Creek
Dry Fork
Uintah Canal
Elkhorn Canal
Whiterocks Canal
Cart Hollow Lateral
Hades Hollow Lateral
Henry Mtn Canal
Upper Pelican Lateral
Lower Pelican Lateral
Duchesne County
Uintah County
40
LOCATION MAP
SALT LAKE CITY
PROVO
FILLMORE
UTAH
CENTRAL UTAH PROJECT
UINTAH UNIT
N.
EXPLANATION
Non-Indian Water Right Land Suitable For Supplemental Irrigation Service
Indian Water Right Land To Receive Supplemental Irrigation Service
Indian Water Right Land Suitable For Full Irrigation Service
Proposed Reservoir
Proposed Lake Modification
Proposed Canal Rehabilitation
Proposed Canal
3 0 3 6 9
SCALE OF MILES
UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
CENTRAL UTAH PROJECT
UINTAH UNIT—UTAH
GENERAL MAP
MARCH 1968
(REV. JULY 1970)
70-418-96

The Uintah Unit is part of the Ultimate Phase of the Central Utah Project. The main features of the unit will be two storage reservoirs. Uinta Reservoir will have the capacity of more than 47,000 acre-feet and be located on Indian lands on the Uinta River. The reservoir will be within 3/4 mile of the Forest boundary. We will request a minimum flow in the Uinta Reservoir between the present canal that diverts water from the National Forests into a powerplant system and the Uinta Reservoir. The Whiterocks Reservoir, situated on Whiterocks River, will have a capacity of 32,000 acre-feet and will be inside the Ashley National Forest. Streamflow will be requested below this reservoir.

Whiterocks River

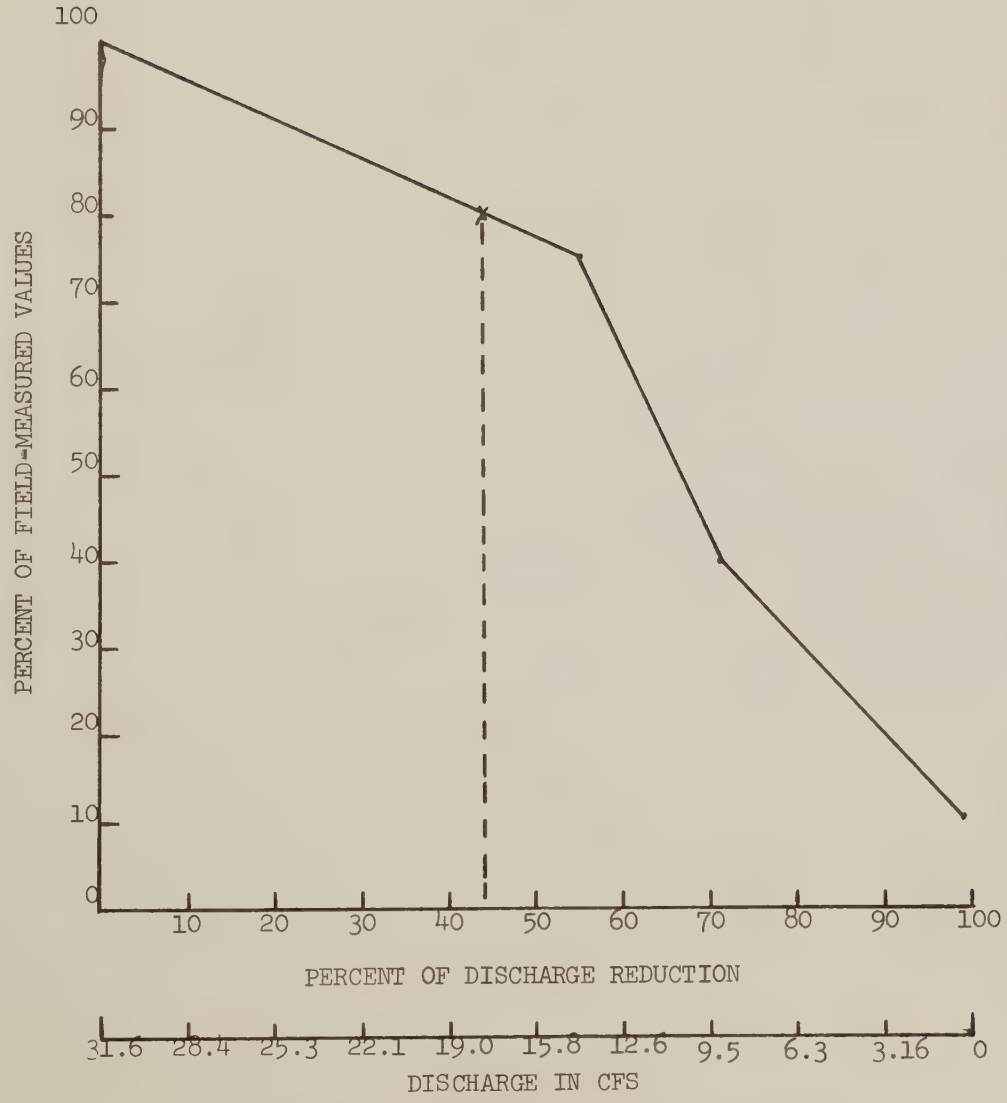
The proposed Whiterocks Dam and Reservoir will inundate approximately 2 miles of the Whiterocks River. Aquatic habitat downstream from the dam site to the Forest boundary, a distance of about 1.8 miles, could be severely impacted without an adequate flow release from the dam.

A habitat survey of the stream below the damsite was made in 1963 and resurveyed again in 1965. A release of 17 cfs was recommended to retain the downstream aquatic habitat. One station was established approximately 0.5 mile below the proposed damsite.

Station 1, Whiterocks River

The habitat-discharge trend relationship indicates a rapid decline of habitat characteristics will occur below 14 cfs as shown in Figure 26. A 44 percent reduction from the base-measured flow of about 32 cfs to 17 cfs would provide a habitat retention of 80 percent of the physical stream characteristics. The absolute minimum flow should not fall below 15 cfs. The proposed release of 7 cfs in the operation plan would be inadequate to sustain a fishery as indicated in Figure 26.

A comparison of the recommended 17 cfs release below the dam is shown in relation to the historic high, low, and mean monthly flow for USGS gage 9-2995, Figure 27. The flow duration curve for this gage also indicates a flow of 17 cfs would be attained about 99 percent of the time, Figure 28. A flow of 15 cfs would be attained 100 percent of the time. The recommended flow of 17 cfs should be required, although a compromise of 15 cfs would be the absolute minimum desired for retention of aquatic habitat.



100% Field-Measured Values[1/]

Water Surface	
Wetted Perimeter	
Max. Depth	1.5 ft
Ave. Depth	0.9 ft
Discharge	31.6 cfs
Velocity	
Habitat	38% opt

Diversions

Flow slightly regulated by small mountain lakes. One small irrigation diversion.

Historical Flow Records

△U.S.G.S. 9-2995

Minimum 10 cfs 12/5/33

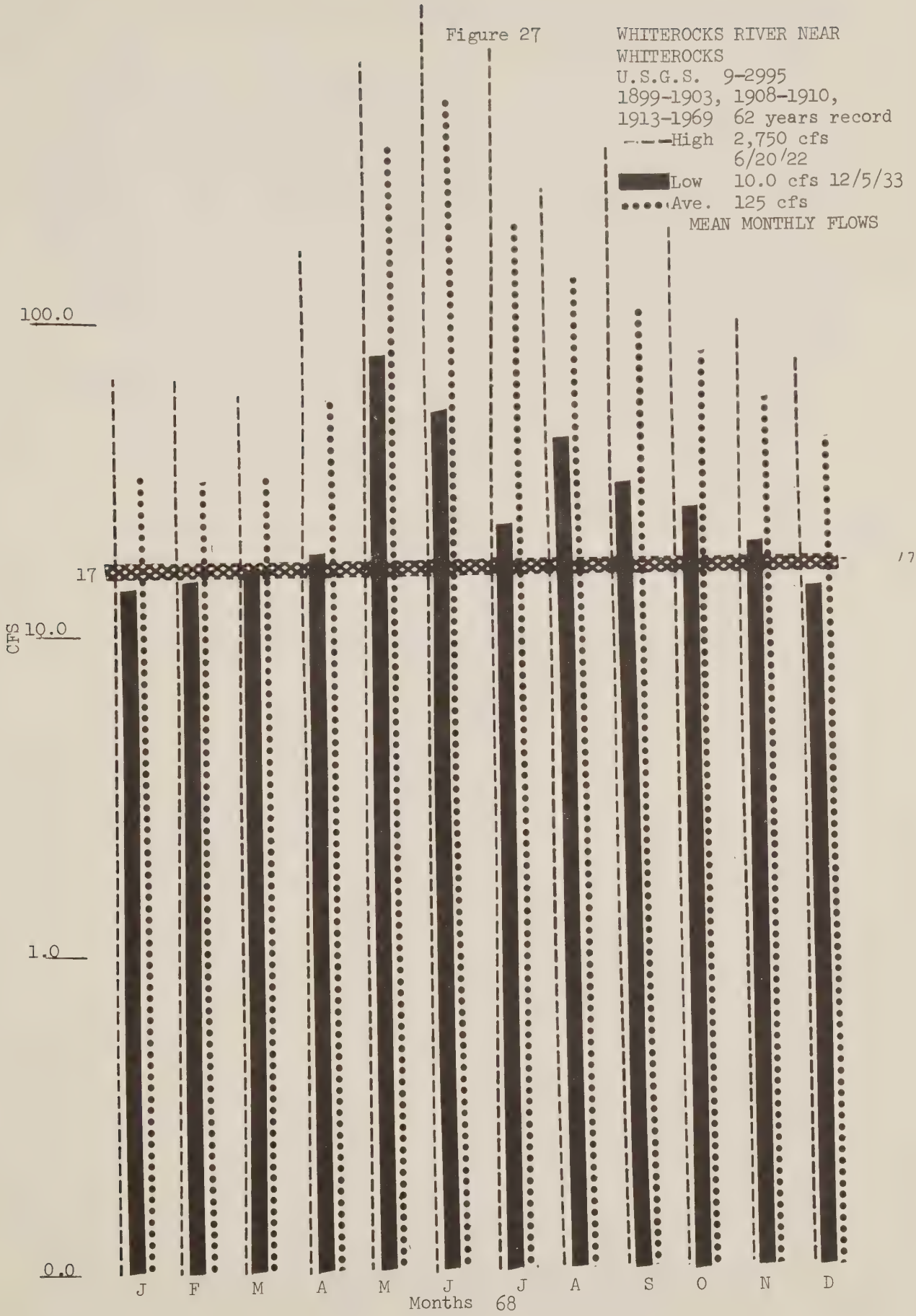
Maximum 2,750 cfs 6/20/22

Average 125 cfs

[1/] Data taken from original report March 1968.

Figure 26
WHITEROCKS RIVER
Station #1 - one-half mile below damsite

Figure 27


WHITEROCKS RIVER NEAR WHITEROCKS
U.S.G.S. 9-2995
1899-1903, 1908-1910,
1913-1969 62 years record
High 2,750 cfs 6/20/22
Low 10.0 cfs 12/5/33
Ave. 125 cfs
MEAN MONTHLY FLOWS
100.0
17
10.0
1.0
0.0
CFS
J F M A M J J A S O N D
Months

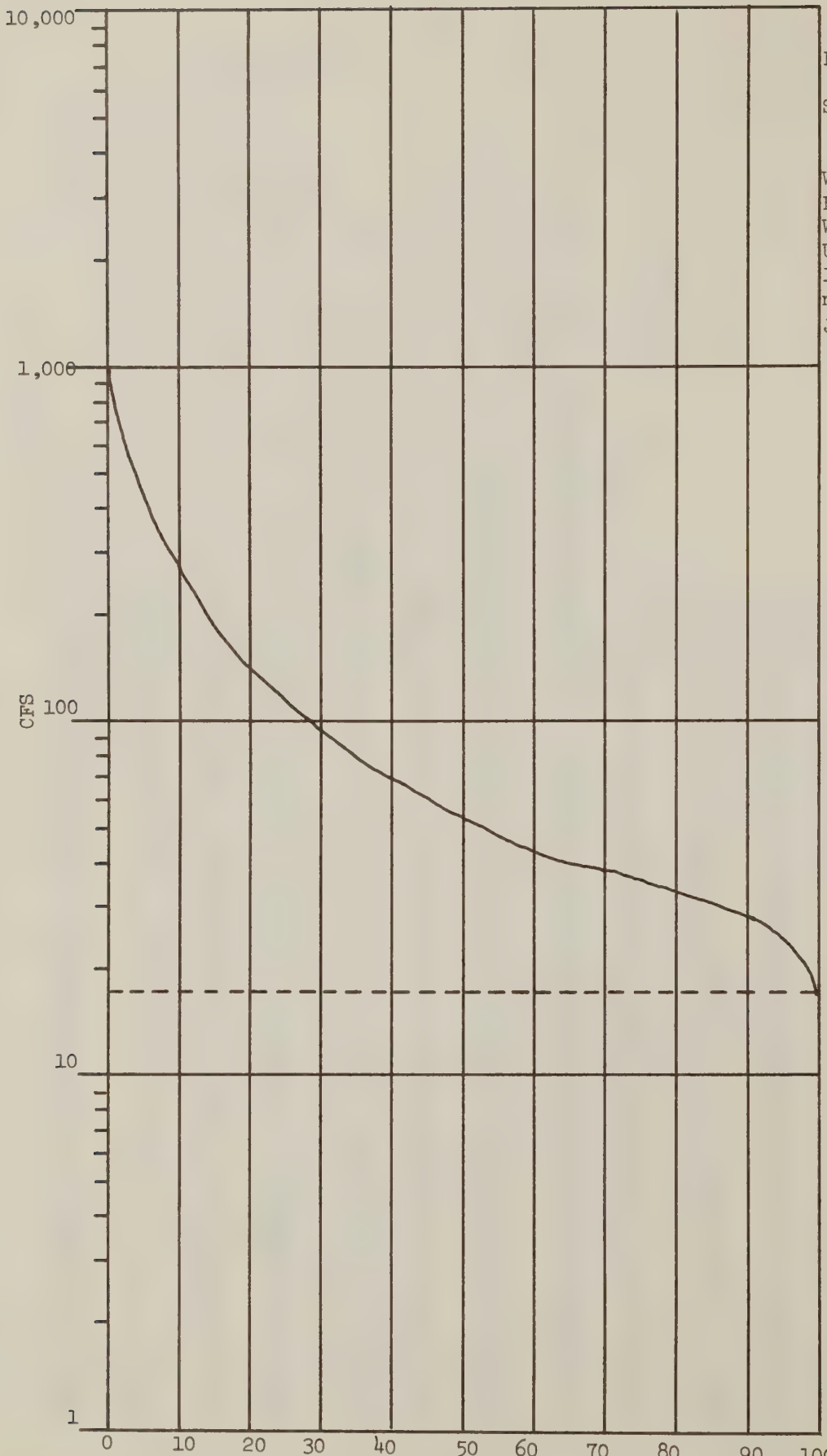


Figure 28

Station No. 2995

Whiterocks River near Whiterocks, Utah, 1910, 1937-57, not adjusted.

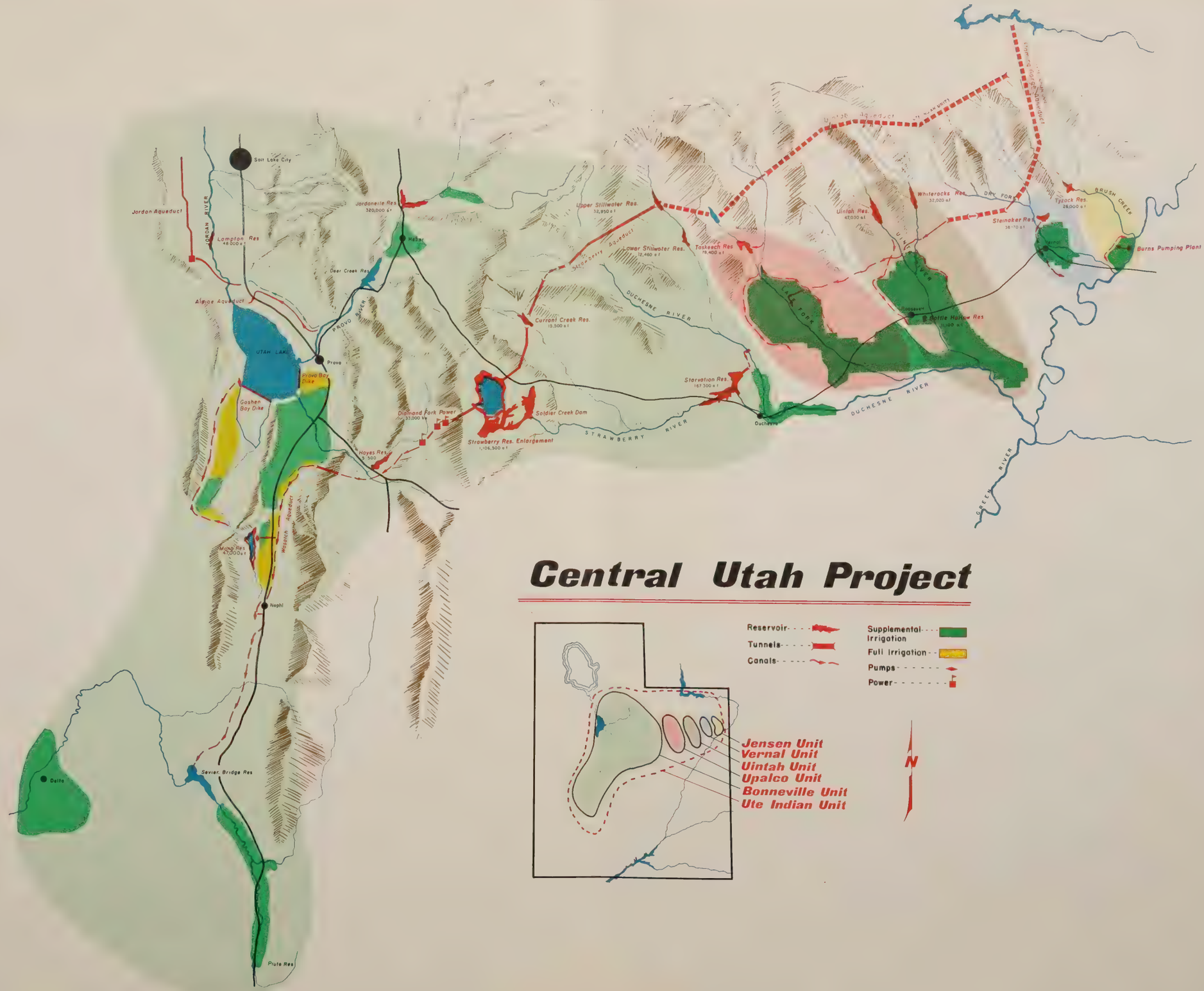
Daily discharge in cfs that was equaled or exceeded for indicated percentage of time.

Uinta River

The Uinta Dam and Reservoir will not be located on Forest Service lands. However, there is an existing canal which diverts water from the river to Uintah Power and Light Company powerplant. The diversion point is located about 0.5 mile inside the Forest boundary. The canal provides a limited fishery.

As part of the Uinta project, proposed plans call for the elimination of the power complex. This will provide an opportunity to retain the canal as a fishery since reduced downstream flows will occur below the Uinta Dam and Reservoir. The flows to sustain a fishery in the canal will be returned to the reservoir below the Forest boundary. Water not diverted into the canal will flow in the river channel and into the reservoir. The aquatic habitat in this 0.5-mile section of the river can be retained as well as the fishery in the canal.

The water necessary to retain a fishery in the canal will be obtained from flows of the Indians Big Springs and will be flumed across Uinta River. These flows vary from 7 to 15 cfs.


Central Utah Project
Salt Lake City
Jordan Aqueduct
JORDAN RIVER
Lompton Res
46,000 a-f
Jordanelle Res
320,000 a-f
Heber
Deer Creek Res
PROVO RIVER
Alpine Aqueduct
UTAH LAKE
Provo
Provo Bay Dike
Goshen Bay Dike
Diamond Fork Power
33,000 kw
Hayes Res
2,500
Strawberry Res. Enlargement
1,106,500 a-f
Soldier Creek Dam
STRAWBERRY RIVER
Upper Stillwater Res.
32,950 a-f
Stillwater Aqueduct
Lower Stillwater Res.
12,460 a-f
Currant Creek Res.
13,300 a-f
DUCHESNE RIVER
Moon Res
47,000 a-f
Wasatch Aqueduct
Nephi
Sevier Bridge Res
Delta
Piute Res
Uinta Aqueduct
Uintah Res.
47,000 a-f
Whiterocks Res.
32,000 a-f
DRY FORK
Steinaker Res
38,700 a-f
Tyzack Res.
26,000 a-f
BRUSH CREEK
Burns Pumping Plant
Vernal
Duchesne
Starvation Res.
167,300 a-f
Little Hollow Res
11,100 a-f
DUCHESNE RIVER
GREEN RIVER
Reservoir
Tunnels
Canals
Supplemental Irrigation
Full Irrigation
Pumps
Power
Jensen Unit
Vernal Unit
Uintah Unit
Upalco Unit
Bonneville Unit
Ute Indian Unit
N

The Ute Indian Unit now under study may encompass and tie together all other units and will be the most vital of the Central Utah Project. Its cost would exceed $600,000,000 and would be the most complicated of all of the units involving dams, pipelines, aqueducts, canals, diversion dams, pumping plants, dikes, powerplants, and exchange of water.

Two major aqueducts, the principal features of the Ute Indian Unit, will make Colorado River water readily available to both the Bonneville and Uintah Basins. Uintah Aqueduct will be an extension of the Strawberry Aqueduct being constructed as part of the Bonneville Unit and will collect water from Uinta streams and transfer it to the enlarged Strawberry Reservoir and on into the Bonneville Basin. As originally planned, streams diverted from Uintah Basin into Bonneville may be Little Brush, Big Brush, Ashley Creek, Dry Fork, Whiterocks, Uinta, Yellowstone, Lake Creek, and Rock Creek.

Flaming Gorge Aqueduct will convey water from Flaming Gorge Reservoir into the Uintah Basin replacing water that has been released to the Bonneville Basin through the Uintah Aqueduct and will provide additional quantities to the Uintah Basin. Planning for this unit has not been firmed up at this time; however, the releases that we are requesting in this report are based on some of the original planning for the unit and involve the previously mentioned streams. These may require changes as the advanced planning is completed.

Little Brush Creek

The flows in Little Brush Creek are regulated through downstream releases from East Park Reservoir. Several springs and accretion flows provide some water for fisheries in the stream. Little Brush Creek is rated as both a Class III and Class IV stream. The major portion of the stream, approximately 18.6 miles, falls into the Class IV rating primarily because of dewatering during the non-irrigation season when flows are diverted for storage.

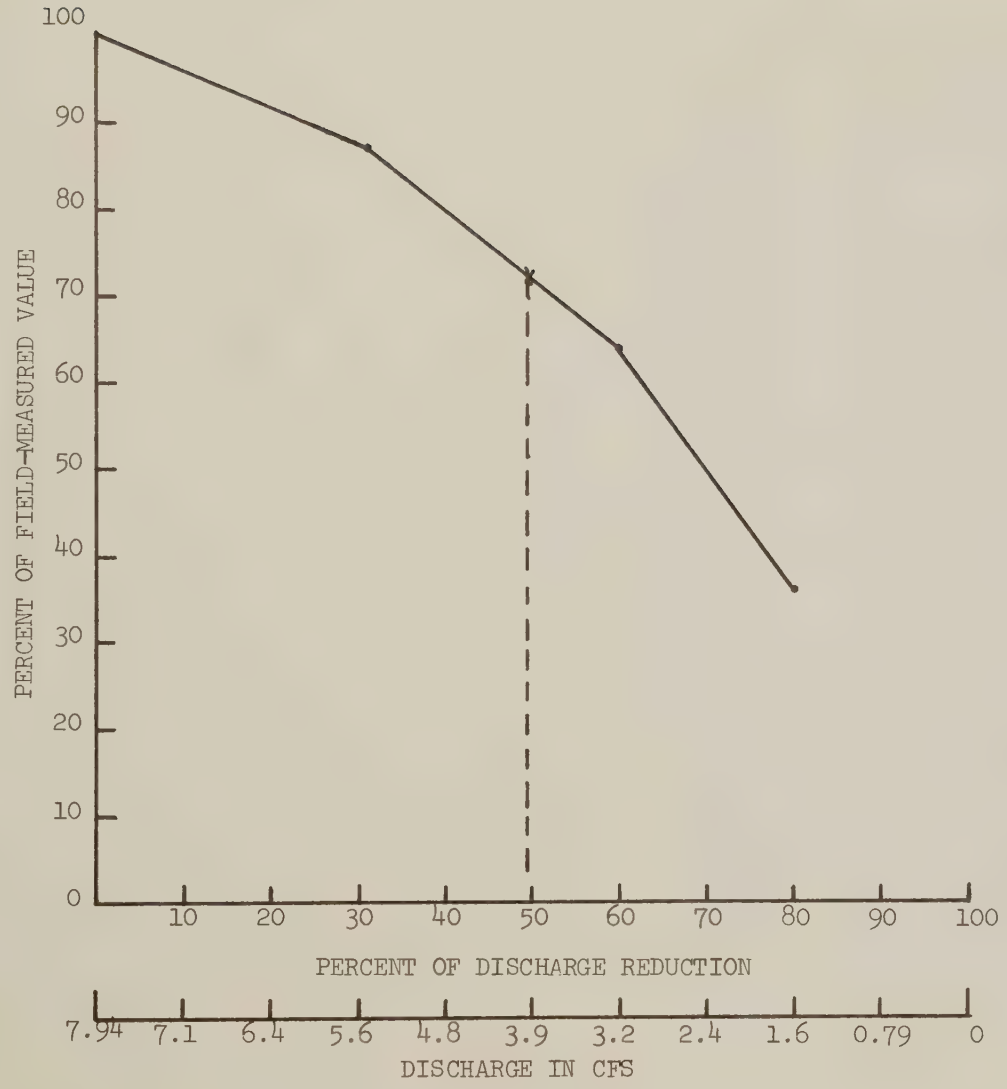
Game fish species in Little Brush Creek consist of natural cutthroat trout and some reproduction of brook trout from a previous plant in 1965. The majority of fishing pressure is supported through periodic stocking of legal-size rainbow trout.

The initial plans for the Ute Indian Unit include the enlargement of the East Park Reservoir to store winter and high spring flows. The collected water would then be transported to the Bonneville Basin through the proposed aqueduct system. Two new earth dams are proposed which will be on the East and West Forks of Little Brush Creek. The dam on the East Fork will eliminate about 2 miles of flow until its confluence with the West Fork because of storage. The proposed dam on the West Fork will have a flow from the outlet works and spillway. Downstream releases are recommended to sustain adequate habitat below the confluence of the two forks.

Three study stations were established below the junction of the East and West Forks. A sustained release flow of 4 cfs is recommended to improve and sustain the aquatic habitat in the stream below the diversion points.

Station 1, Little Brush Creek

Aquatic habitat values at station 1 decrease rapidly with a discharge reduction above 30 percent of the base-measured flow of 9 cfs as indicated in Figure 29. A 50 percent reduction in the base-measured flow would retain about 72 percent of the field-measured habitat values at a discharge of 4 cfs. This flow would fall below the desired retention point of 80 percent habitat which would normally be expected at a discharge reduction of 40 percent of the base flow as indicated in the graph relationship. Habitat losses below a reduction of 50 percent discharge at 4 cfs would be at the critical recovery point. A flow of 4 cfs would be adequate to sustain a fair fishery and also prevent degradation of the stream habitat. A comparison of the stream channel features at three water level stages below the base flow of 8 cfs is shown in Figure 30.



100% of Field-Measured Values	
Water Surface	12.2 ft
Wetted Perimeter	16.7 ft
Maximum Depth	1.5 ft
Average Depth	0.4 ft
Discharge	7.940 cfs
Velocity	1.21 fps
Pools rated 1,2,3	40% sample
Habitat	51% optimum

Diversions
Flow regulated by East Park Reservoir

Historical Flow Records
USGS Δ 415 92625 1949-1955
6 years

Minimum	0.1 c.f.s. 9/18/61
Maximum	409 c.f.s. 5/30/50
Average	13.3 c.f.s.

Figure 29
LITTLE BRUSH CREEK
Station #1 - 2 miles Upstream from Access Road on East Park Reservoir Road, 1/4 mile above Diversion

Scale:
Horizontal 1" - 2 ft
Vertical 1" = 1 ft

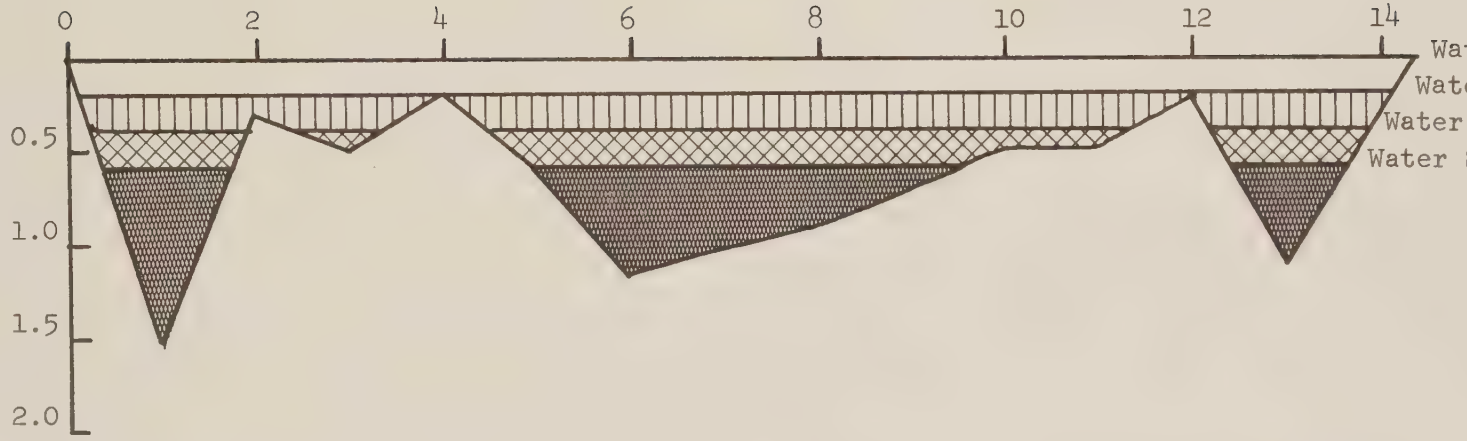
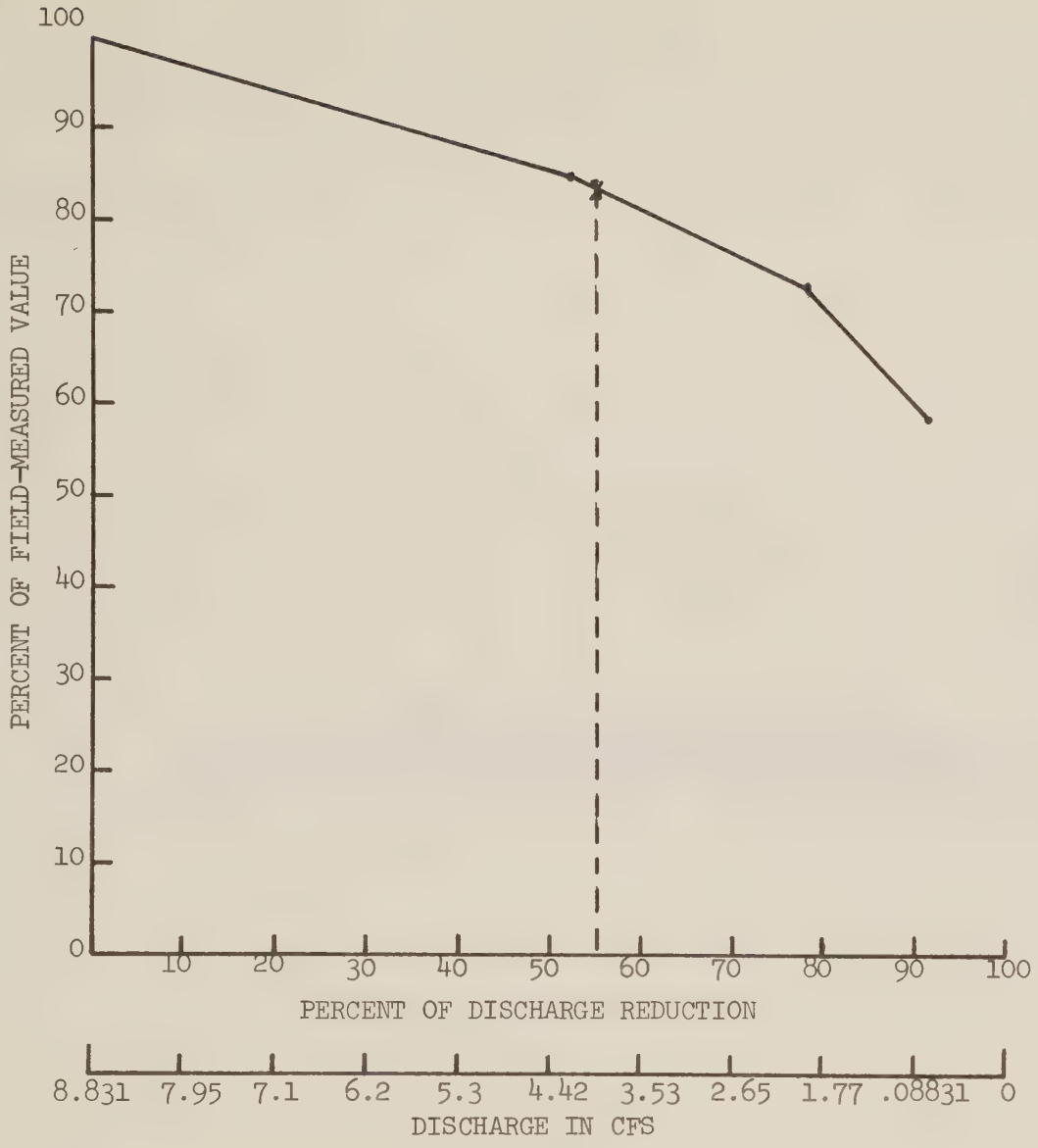


Figure 30
LITTLE BRUSH CREEK
Station #1 - 2 miles upstream from access road on East Park Reservoir 1/4 mile below diversion

Water Stage	Discharge	%	Velocity	%	Max. Depth	%	Ave. Depth	%	Area	%	Water Surface	%	Wetted Perimeter	%	Habitat Retained	%
0	7.940 cfs	100	1.21 fps	100	1.5 ft	100	0.4 ft	100	6.56 sqft	100	12.2 ft	100	16.7 ft	100	51% opt	100
1	5.435 cfs	69	1.07 fps	88	1.3 ft	87	0.3 ft	75	4.08 sqft	77	11.4 ft	93	15.6 ft	93	44% opt	87
2	3.162 cfs	40	0.93 fps	77	1.1 ft	73	0.2 ft	50	3.40 sqft	52	7.8 ft	64	12.8 ft	77	33% opt	64
3	1.566 cfs	20	0.87 fps	72	0.9 ft	60	0.1 ft	25	1.80 sqft	27	5.0 ft	41	8.8 ft	53	18% opt	36

Station 2, Little Brush Creek

A release of 4 cfs, as recommended for Station 1, would retain about 83 percent of the habitat characteristics at station 2. This would amount to a flow reduction of 55 percent from the base flow of about 9 cfs at this point on the stream, Figure 31. A comparison of the stream channel features at three different water level stages from the base flow is shown in Figure 32. Discharge measurements at Station 2 indicate there is usually a slight gain in discharge between Stations 1 and 2.



100% of Field-Measured Values	
Water Surface	14.8 ft
Wetted Perimeter	15.4 ft
Maximum Depth	0.7 ft
Average Depth	0.5 ft
Discharge	8.831 cfs
Velocity	1.17 fps
Pools rated 1,2,3	8% sample
Habitat	52% optimum

Diversions
Flows regulated by East Park Reservoir

Historical Flow Records
Δ 415 9-2625 1949-1955
6 years

Minimum	0.1 c.f.s.	9/18/61
Maximum	409 c.f.s.	5/30/50
Average	13.3 c.f.s.	

Figure 31
LITTLE BRUSH CREEK
Station #2 - 1/2 mile above access road on East Park Reservoir and below Big Sagebrush area

Scale:
Horizontal 1" = 2 ft
Vertical 1" = 1 ft

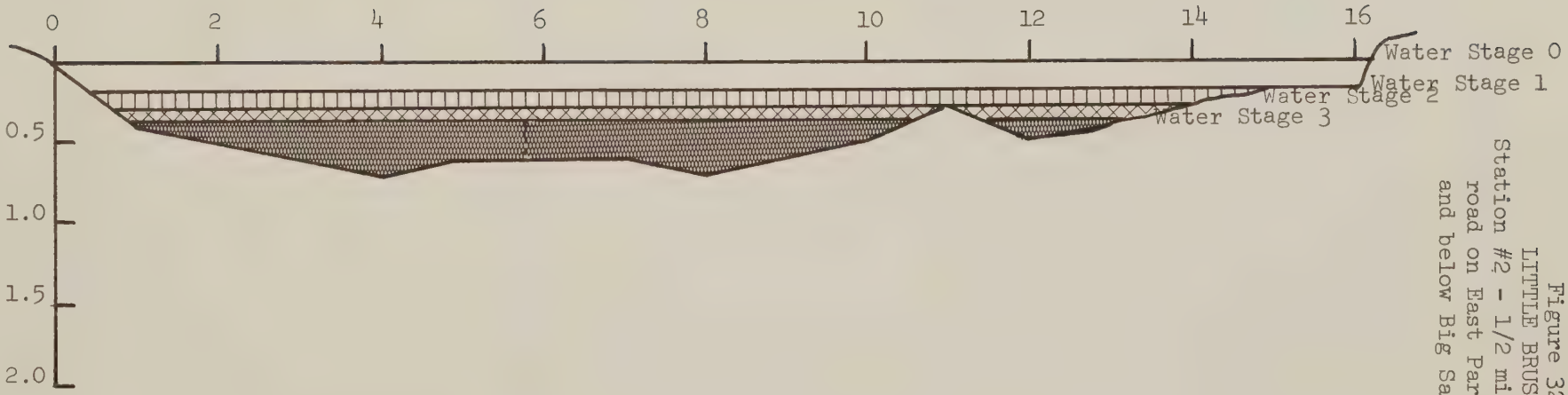


Figure 32
LITTLE BRUSH CREEK
Station #2 - 1/2 mile above access road on East Park Reservoir and below Big Sagebrush area

Water Stage	Discharge	%	Velocity	%	Max. Depth	%	Ave. Depth	%	Area	%	Water Surface	%	Wetted Perimeter	%	Habitat Retained	%
0	8.831 cfs	100	1.17 fps	100	0.7 ft	100	0.5 ft	100	7.57 sqft	100	14.8 ft	100	15.4 ft	100	53% opt	100
1	4.195 cfs	48	0.92 fps	79	0.5 ft	71	0.3 ft	60	4.56 sqft	60	14.7 ft	99	15.0 ft	97	44% opt	85
2	2.148 cfs	24	0.68 fps	58	0.4 ft	57	0.2 ft	40	3.16 sqft	42	12.7 ft	86	14.4 ft	94	38% opt	73
3	0.752 cfs	9	0.47 fps	40	0.3 ft	43	0.1 ft	20	1.60 sqft	21	11.2 ft	76	12.5 ft	81	31% opt	59

Station 3, Little Brush Creek

The habitat trend-discharge relationship at this point in the stream does not fall as rapidly as at measured stations above this stream section. The recommended release of 4 cfs from East Park Reservoir would provide retention of about 85 percent of the measured habitat characteristics at a 55 percent reduction in the base-measured flow of 9 cfs, Figure 33. Comparison of stream channel features at three water stages below the base flow of about 9 cfs is shown in Figure 34. Discharge gains between Stations 3 and 2 are very slight and would not be significant.

Figure 33
LITTLE BRUSH CREEK
Station #3 - 1/4 mile below access road on East Park Reservoir Road and above gravel pit near highway

Scale:
Horizontal 1" = 4 ft
Vertical 1" = 1 ft

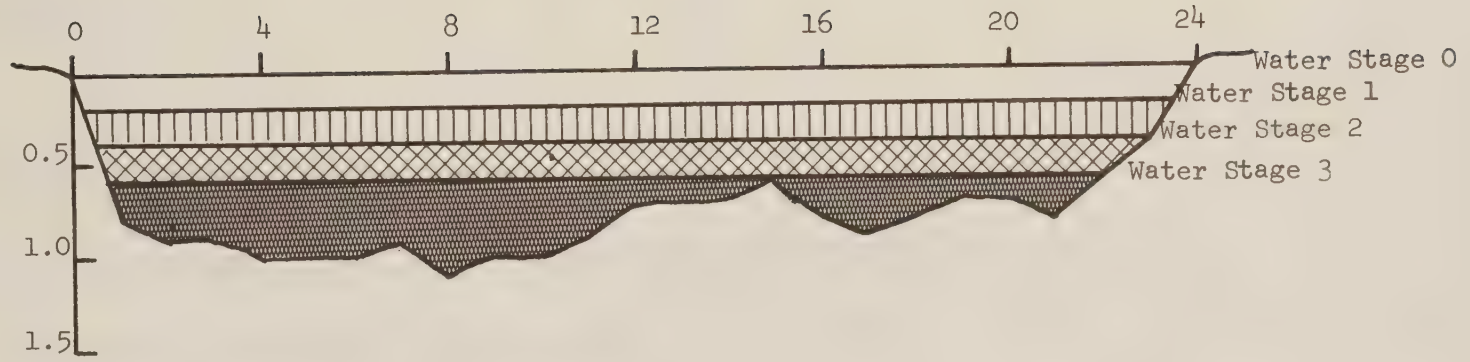


Figure 34
LITTLE BRUSH CREEK
Station #3 - 1/4 mile below access road on East Park Reservoir Road and above gravel pit near highway

Water Stage	Discharge	%	Velocity	%	Max. Depth	%	Ave. Depth	%	Area	%	Water Surface	%	Wetted Perimeter	%	Habitat Retained	%
0	8.914 cfs	100	0.48 fps	100	1.1 ft	100	0.8 ft	100	18.57 sqft	100	22.0 ft	100	23.1 ft	100	51% opt	100
1	5.951 cfs	67	0.43 fps	90	0.9 ft	82	0.6 ft	75	13.84 sqft	75	21.9 ft	99	22.7 ft	98	46% opt	91
2	2.784 cfs	31	0.30 fps	63	0.7 ft	64	0.4 ft	50	9.28 sqft	50	21.7 ft	99	22.2 ft	96	42% opt	82
3	1.041 cfs	12	0.21 fps	44	0.5 ft	46	0.2 ft	25	4.96 sqft	27	20.8 ft	95	21.2 ft	92	36% opt	71

Two stream gages were maintained on Little Brush Creek for a short period of time. The first gage, USGS 415 later 9-2625, was installed 2 miles downstream from East Park Reservoir and operated from 1949 to 1955. A comparison of the recommended release of 4 cfs in relation to the regulated flows from East Park Reservoir is shown in Figure 35. The second gage, USGS 416 later 9-2630, was located approximately 3/4 of a mile above Kane Hollow and operated from 1945 to 1952. A comparison of the recommended release in relation to the recorded historic mean flows is shown in Figure 36.

Figure 35
LITTLE BRUSH CREEK BELOW
EAST PARK RESERVOIR
U.S.G.S. 9-2625
1949-1955 6 years record
High 409 cfs 5/30/50
Low 0.1 cfs 11/4/54
Ave. 13.3 cfs

MEAN MONTHLY FLOW

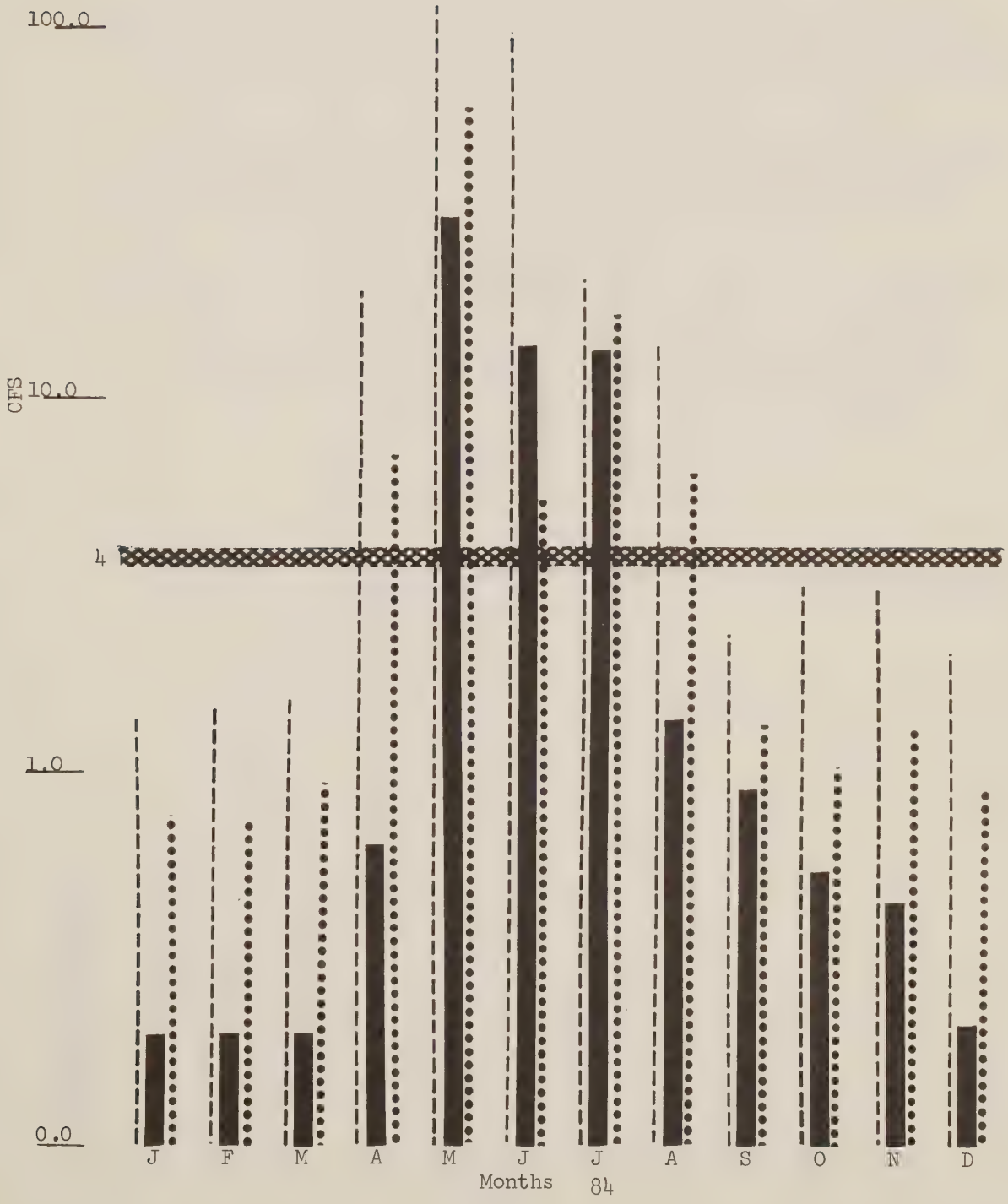
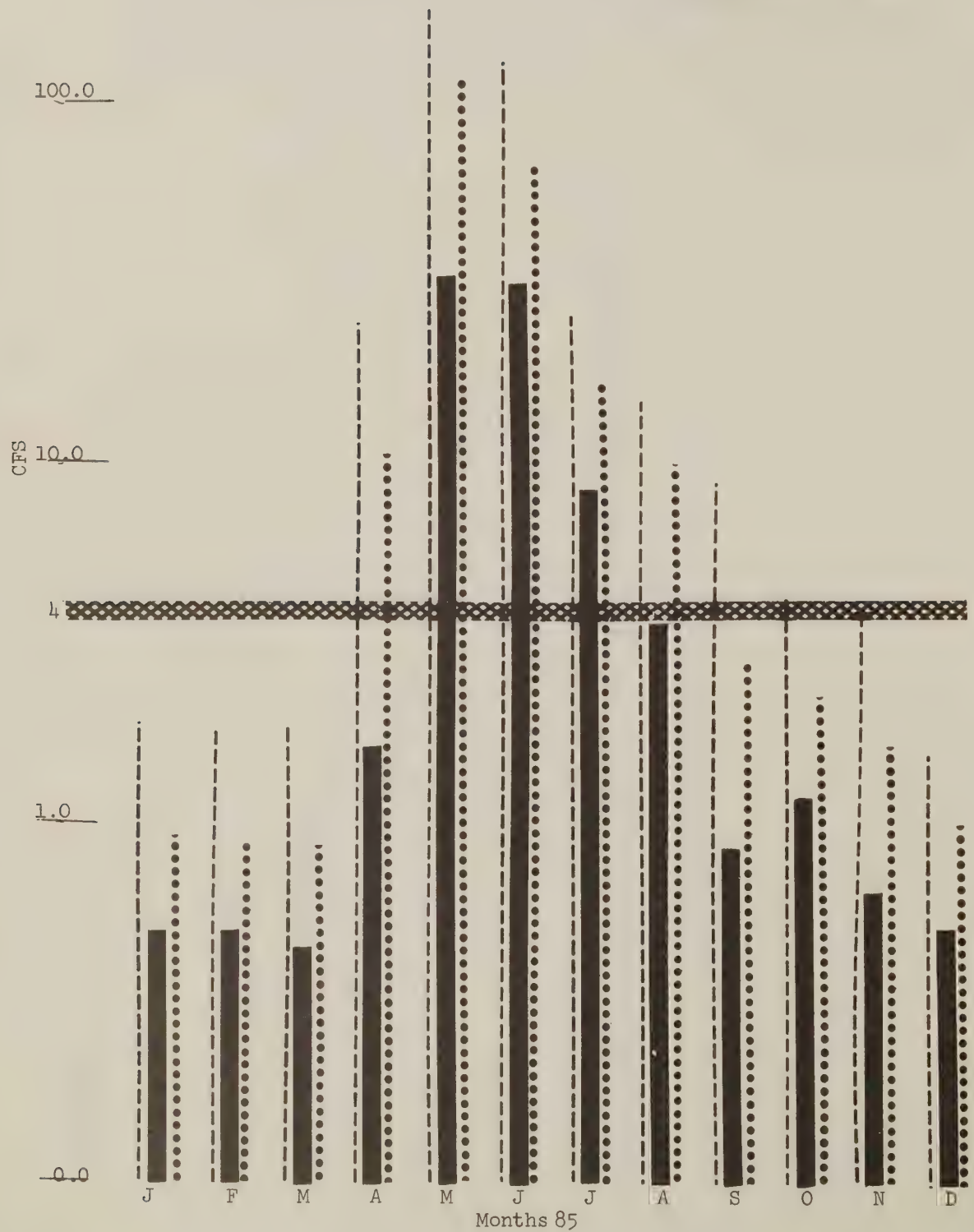


Figure 36
LITTLE BRUSH CREEK NEAR VERNAL
U.S.G.S. 9-2630
1945-1952 7 years record
High 608 cfs 5/30/50
Low 0.1 cfs 9/18/61
Ave. 19.9 cfs

MEAN MONTHLY FLOWS



Big Brush Creek

The Oaks Park Reservoir presently regulates the flow in Big Brush Creek and also diverts water from Big Brush Creek into the Ashley Creek drainage via the Oaks Park Canal. A proposed diversion dam on Brush Creek below the reservoir will channel the stream flow into the Uintah Aqueduct for transmission to the enlarged Strawberry Reservoir.

Water flows in Big Brush Creek disappear into Brush Creek Cave and emerge approximately 7 miles downstream at Brush Creek Spring, 2.5 miles above the Forest boundary.

Big Brush Creek, from the Forest boundary upstream to the spring, has a Class III rating which indicates some natural reproduction does occur for trout. Rainbow trout are periodically planted to sustain the fishery.

Three stations were established on Big Brush Creek. A sustained release flow of 3 cfs from Oaks Park Reservoir is recommended to maintain aquatic habitat values above Brush Cave. Accretion flows and flows arising from Brush Creek Spring should provide a flow of about 8 cfs below the spring to the Forest boundary.

Station 3, Big Brush Creek

A reduction of 57 percent of the base-measured flow of 7 cfs would indicate a sustained release of 3 cfs from Oaks Park Reservoir would sustain aquatic habitat values at approximately 83 percent of measured characteristics, Figure 37. A comparative view of the stream channel cross section is shown in Figure 38.

Figure 37
BIG BRUSH CREEK
Station #3 - above Brush Creek Cave
at bridge - 15 feet below bridge

Scale:
Horizontal 1" = 2 ft
Vertical 1" = 1 ft

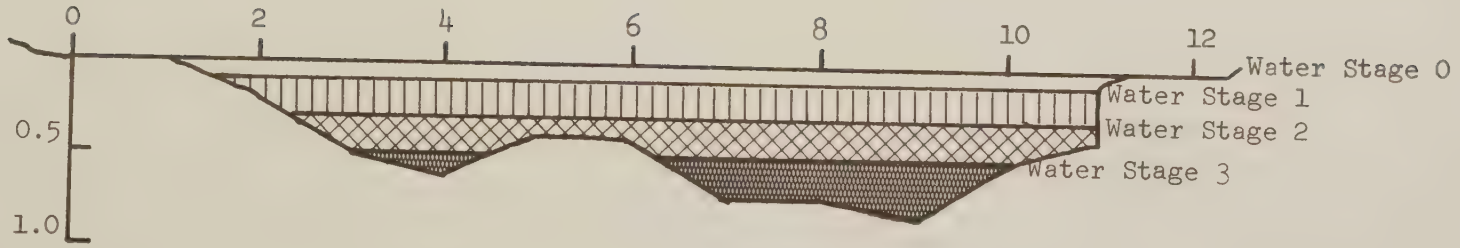


Figure 38
BIG BRUSH CREEK
Station #3 - above Brush Creek Cave
at bridge - 15 feet below bridge

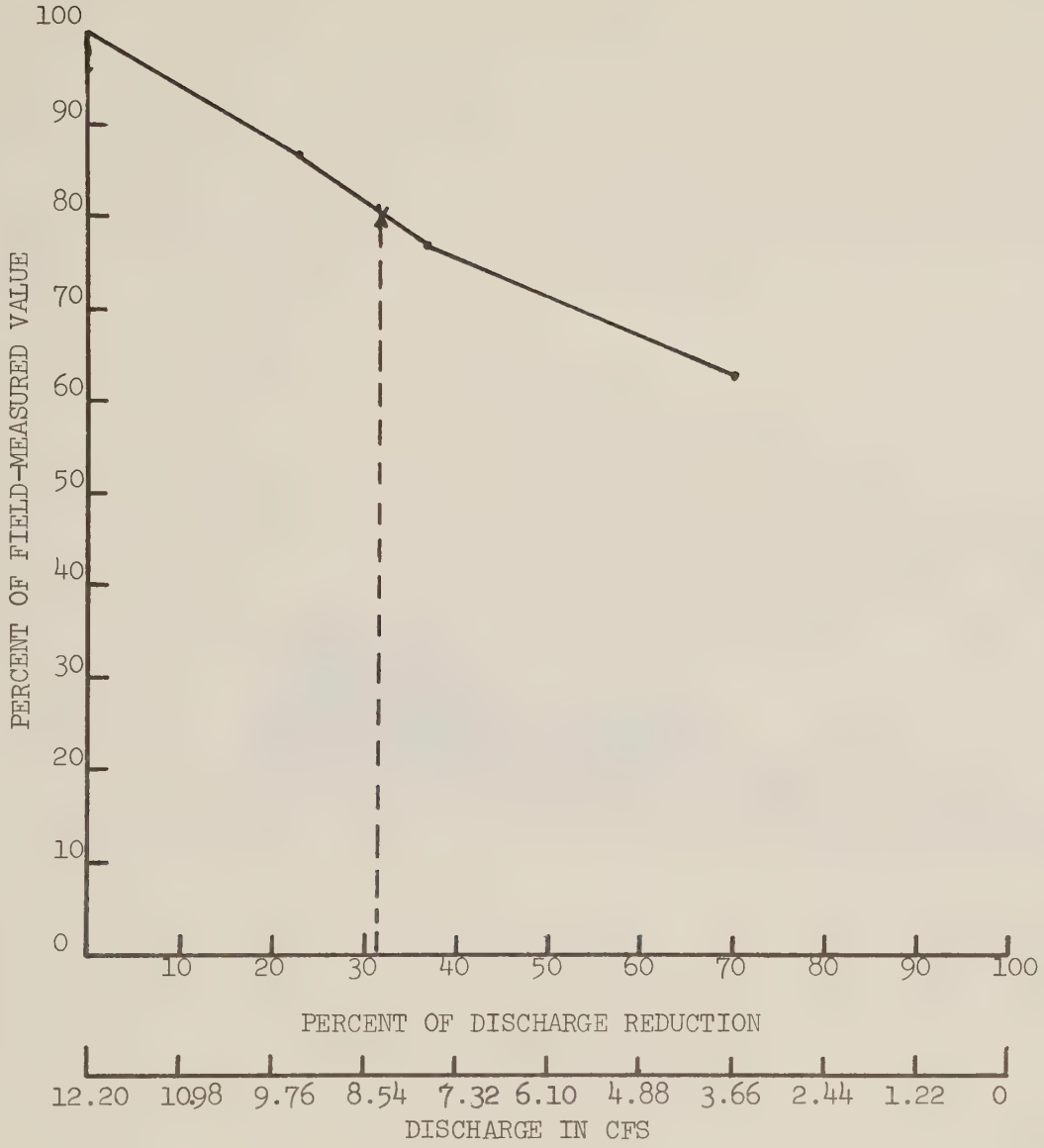
Water Stage	Discharge	%	Velocity	%	Max. Depth	%	Ave. Depth	%	Area	%	Water Surface	%	Wetted Perimeter	%	Habitat Retained	%
0	6.999 cfs	100	1.29 fps	100	0.9 ft	100	0.6 ft	100	5.40 sqft	100	10.4 ft	100	11.6 ft	100	60% opt	100
1	4.748 cfs	68	1.12 fps	87	0.8 ft	89	0.5 ft	83	4.24 sqft	80	10.2 ft	98	11.4 ft	98	56% opt	93
2	2.124 cfs	30	0.83 fps	64	0.6 ft	67	0.3 ft	50	2.56 sqft	47	9.6 ft	92	10.7 ft	92	47% opt	78
3	1.022 cfs	15	0.73 fps	57	0.4 ft	44	0.2 ft	33	1.40 sqft	26	4.5 ft	43	4.5 ft	43	28% opt	46

Station 2, Big Brush Creek

This station is located above the Brush Creek Spring. The base flow measurement of a little more than 1 cfs probably consists of accretion flows and, consequently, is not sufficient to sustain aquatic habitat above this point.

Station 1, Big Brush Creek

Habitat values at this station drop rapidly below the retention objective of at least 80 percent of measured characteristics at water stage reduction from the base-measured flow of about 12 cfs. Aquatic habitat below the spring source to the Forest boundary would be retained at a discharge reduction of 32 percent amounting to a flow of 8 cfs as indicated in the habitat trend-discharge relationship, Figure 39. A comparative view of the stream channel cross section at three water level stages reduced from the base flow of about 12 cfs is shown in Figure 40.



100% of Field-Measured Values	
Water Surface	17.6 ft
Wetted Perimeter	17.9 ft
Maximum Depth	1.2 ft
Average Depth	0.5 ft
Discharge	12.20 cfs
Velocity	1.30 fps
Pools rated 1,2,3	34% sample
Habitat	66% optimum

Diversions

Oaks Park Canal diverts above station from Brush Creek to Ashley Creek Basin. Flow is regulated by Oaks Park Reservoir

USGS 9-2620

Historical Flow Records

Minimum	1.6 cfs 3/12/51
Maximum	442 cfs 6/3/52
Average	34.4 cfs

Figure 39
BIG BRUSH CREEK
Station #1 - 100 yards below spring and directly off trail from phosphate plant

Scale:
Horizontal 1" = 4 ft
Vertical 1" = 1 ft

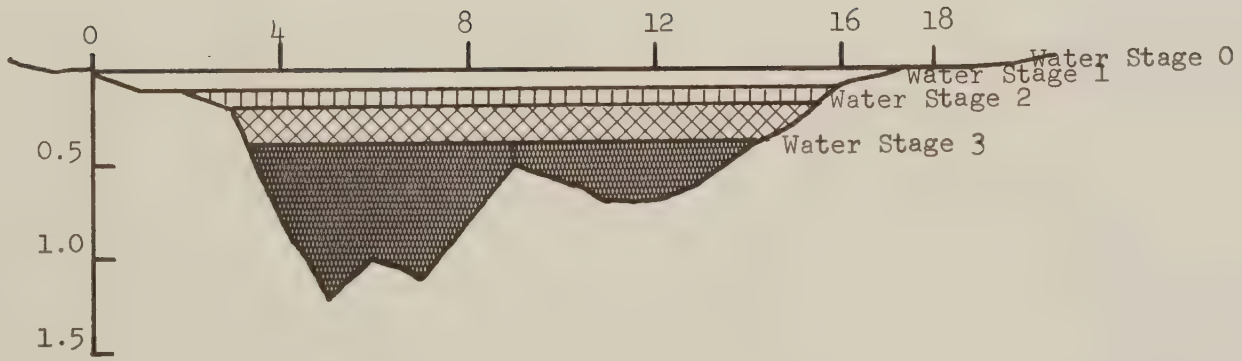


Figure 40
BIG BRUSH CREEK
Station #1 - 100 yards below spring and directly off trail from phosphate plant

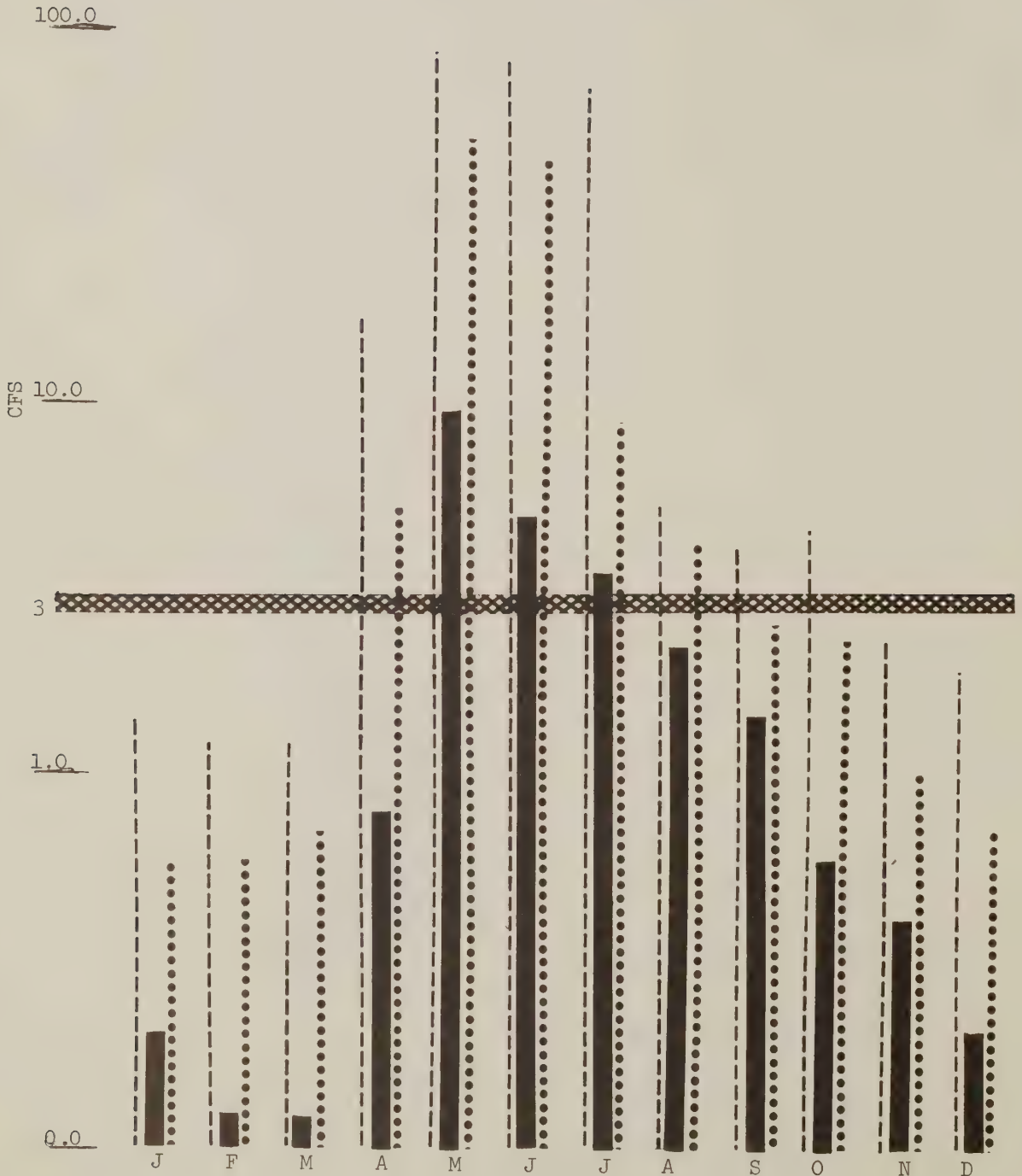
Water Stage	Discharge	%	Velocity	%	Max. Depth	%	Ave. Depth	%	Area	%	Water Surface	%	Wetted Perimeter	%	Habitat Retained	%
0	12.20 cfs	100	1.30 fps	100	1.2 ft	100	0.5 ft	100	9.36 sqft	100	17.6 ft	100	17.9 ft	100	66% opt	100
1	9.42 cfs	77	1.26 fps	97	1.1 ft	92	0.5 ft	100	7.48 sqft	80	13.7 ft	78	15.1 ft	84	57% opt	87
2	7.64 cfs	63	1.18 fps	91	1.0 ft	83	0.4 ft	80	6.48 sqft	69	12.4 ft	71	14.2 ft	79	51% opt	77
3	3.64 cfs	30	0.93 fps	72	0.8 ft	67	0.3 ft	60	3.92 sqft	43	10.7 ft	61	12.4 ft	69	42% opt	63

The flow from Brush Creek Spring would not be affected by the Uinta Aqueduct. The flow from the spring to the Forest boundary would be the natural flow.

A comparison of the recommended flow of 8 cfs in relation to the monthly regulated flows from Oak Park Reservoir is shown in Figure 41. A flow of 8 cfs would normally be attained 100 percent of the time at USGS gage 9-2620 located on Big Brush Creek near Vernal, Utah (Figure 42).

Figure 41
BRUSH CREEK ABOVE CAVE
NEAR VERNAL
U.S.G.S 9-2615
1946-1954 8 years record
High 261 cfs 6/3/52
Low 0.1 cfs 11/8-9/54
Ave. 9.90 cfs

MEAN MONTHLY FLOWS



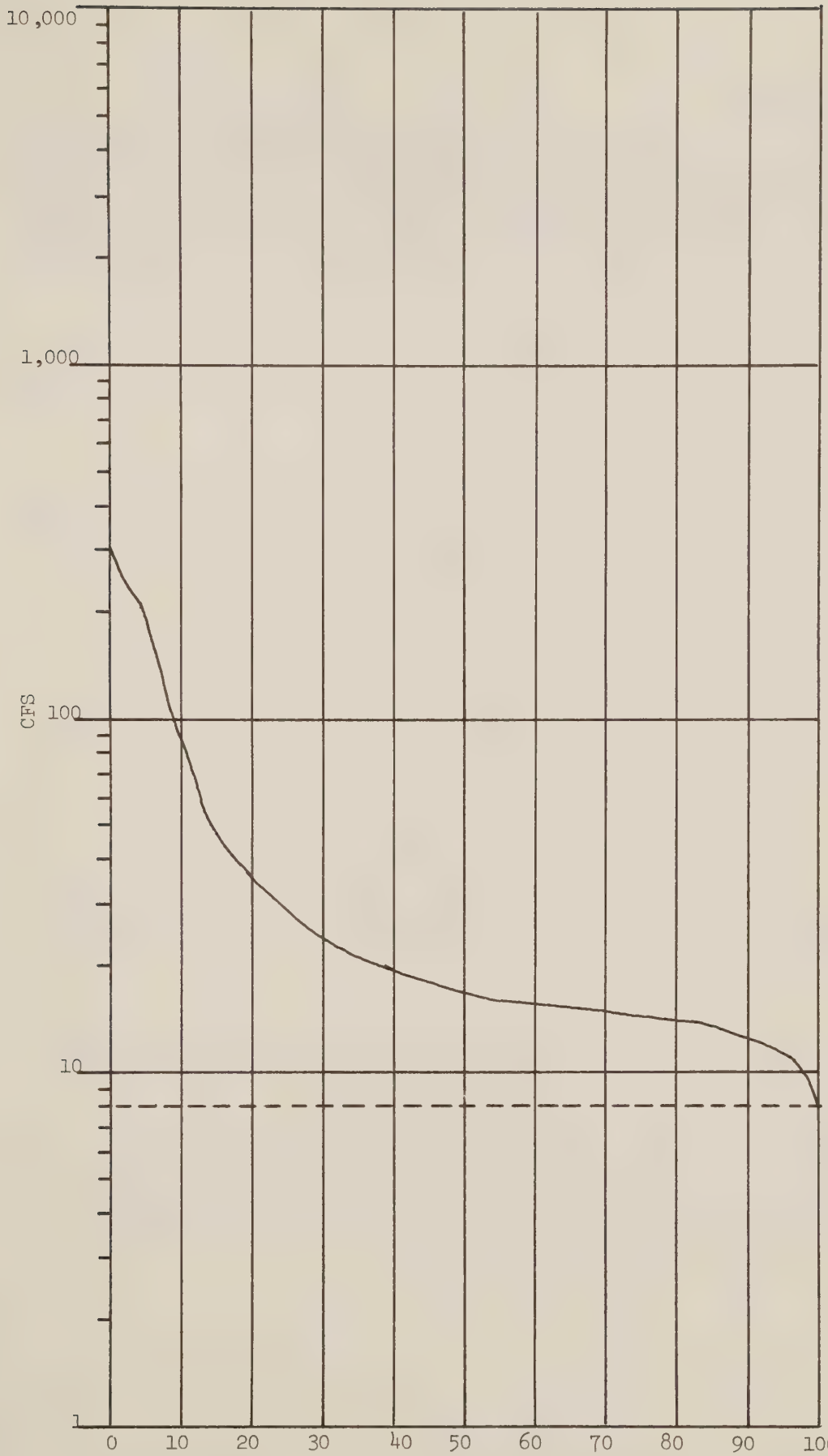


Figure 42

Station
No. 9-2620

Brush
Creek near
Vernal, Ut.
No. of days
6,209

Ashley Creek

The proposed Leidy Dam and Reservoir would eliminate the aquatic habitat and fishery in Trout Creek and the section of North Fork of Ashley Creek which would be inundated. The proposed site for the Leidy Dam is also being considered as the Trout Creek Dam and Reservoir project by the Soil Conservation Service under P.L. 566.

The Leidy Dam and Reservoir will require a diversion from the South Fork of Ashley Creek that would probably dewater the stream for approximatley 3 miles downstream to the confluence with the North Fork of Ashley Creek.

The proposed Uintah Aqueduct would pick up water below the Leidy Dam for transmission to other areas of the project. Downstream aquatic habitat and fisheries would be eliminated. A recommended release below the diversion point of 5 cfs would be required to sustain the downstream aquatic habitat and fisheries.

Present flows in Ashley Creek are slightly regulated by several existing reservoirs. The flow below Trout Creek is partially affected by Long Park Reservoir. Goose Lake and Twin Lakes Reservoirs have a slight effect on flows in South Fork of Ashley Creek. Flows are increased by releases from Oaks Park Reservoir on Brush Creek and diverted to Ashley Creek for irrigation. The lower 15 miles of Ashley Creek does not support a fishery of any value primarily because of diversions and dewatering of the stream. This portion of the stream is rated as Class IV and Class V waters. The upper portion of Ashley Creek is rated as Class III waters indicating some natural fish populations exist in the stream although periodic plants of legal-size rainbow trout supplement the resident cutthroat fishery.

Five stations were established on Ashley Creek beginning below the junction of Trout Creek to just below the Forest boundary. An additional station was established on Cow Hollow Creek.

A recommended release of 5 cfs below the proposed Uintah Aqueduct diversion is determined essential for the retention of the downstream aquatic habitat and fishery. This release is based on accretion flows below this point to sustain the remaining flow requirements at other lower stations.

Station 5, Ashley Creek

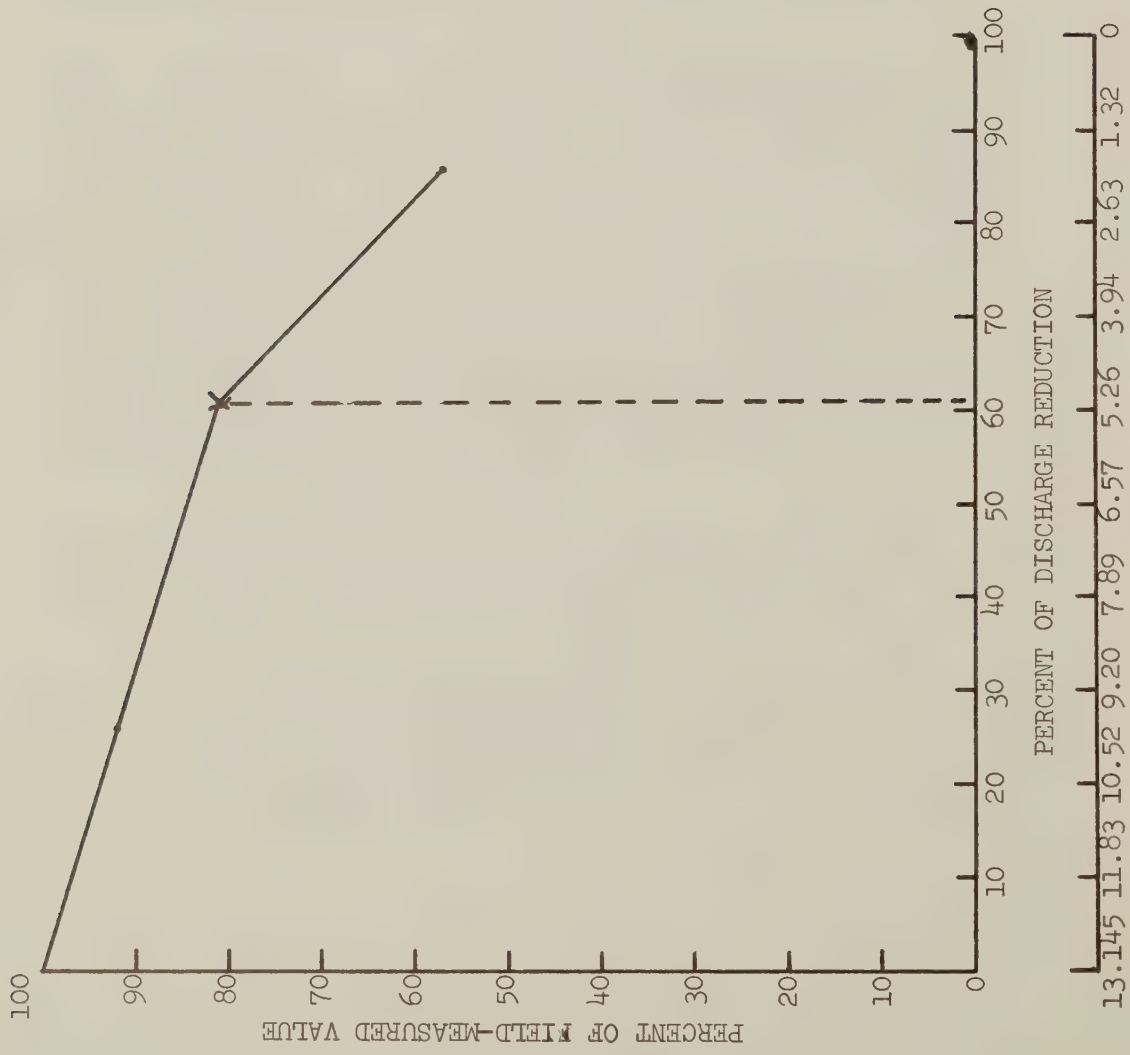
A 61 percent reduction in the base flow of about 13 cfs to 5 cfs would retain about 81 percent of the measured habitat characteristics as shown in the habitat trend-discharge relationship, Figure 43. Streambottom and channel features at three water level reductions from the base-measured flow are shown in Figure 44.

Figure 43

ASHLEY CREEK

Station #5 - 1/2 mile south of Red Cloud Road below Trout Creek

100% of Field Measured Values	
Water Surface	31.2 ft
Wetted Perimeter	34.1 ft
Maximum Depth	1.4 ft
Average Depth	0.9 ft
Discharge	13.145 cfs
Velocity	0.51 fps
Pools rated 1,2,3	42% sample
Habitat	42% optimum



Scale:
Horizontal 1" = 5 ft.
Vertical 1" = 1 ft

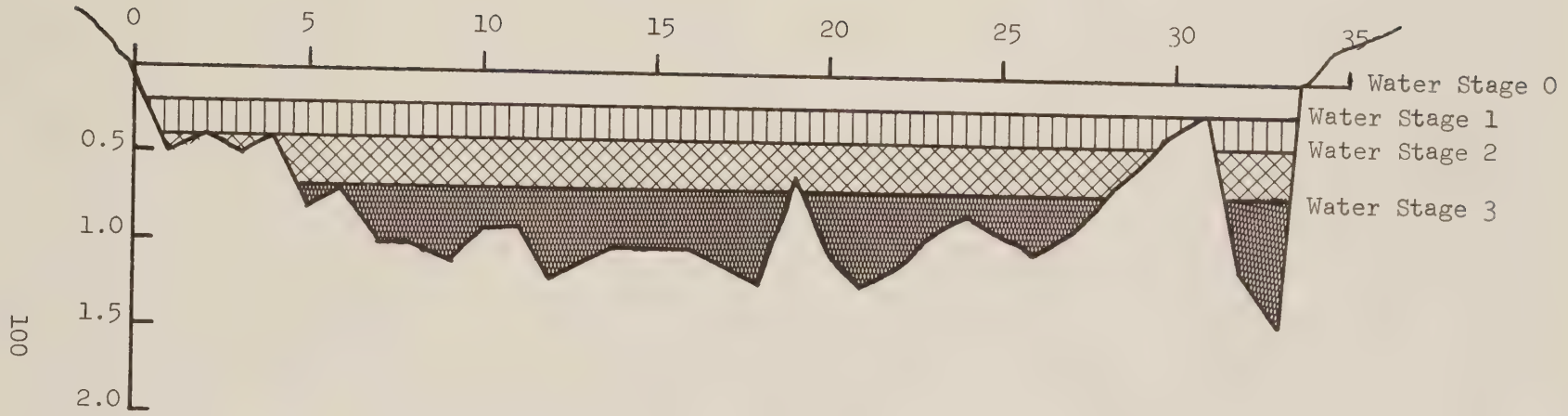


Figure 44
ASHLEY CREEK
Station #5 - 1/2 mile south of
Red Cloud Road below Trout Creek

Water Stage	Discharge	%	Velocity	%	Max. Depth	%	Ave. Depth	%	Area	%	Water Surface	%	Wetted Perimeter	%	Habitat Retained	%
0	13.145 cfs	100	0.51 fps	100	1.4 ft	100	0.9 ft	100	25.85 sqft	100	31.2 ft	100	34.1 ft	100	42% opt	100
1	9.788 cfs	74	0.46 fps	90	1.2 ft	86	0.7 ft	78	21.28 sqft	82	31.2 ft	100	33.7 ft	99	39% opt	92
2	5.097 cfs	39	0.36 fps	71	0.8 ft	57	0.5 ft	56	14.16 sqft	55	29.3 ft	94	31.6 ft	93	34% opt	81
3	1.860 cfs	14	0.30 fps	59	0.7 ft	50	0.2 ft	22	6.20 sqft	24	22.8 ft	73	25.9 ft	76	24% opt	57

Station 4, Ashley Creek

A reduction of 57 percent of the base-measured flow from about 28 cfs to 12 cfs would retain about 82 percent of measured habitat characteristics at this station. Stream flows above the station are partially regulated by Twin Lakes and Goose Lake Reservoirs. The recommended release of 5 cfs from the proposed Leidy Reservoir in addition to the downstream gain between Stations 5 and 4 should attain a discharge of about 12 cfs for this section of the stream. Downstream gains may be influenced by the existing upstream reservoirs. The habitat trend-discharge relationship is shown in Figure 45. Streambottom and channel features, which reduced from 28 cfs to three water levels, are illustrated in Figure 46.

Figure 45
ASHLEY CREEK
Station #4 - 1/4 mile below sheep
trail crossing on Ashley Creek

100% of Field-Measured Values	
Water Surface	21.0 ft
Wetted Perimeter	26.0 ft
Maximum Depth	2.4 ft
Average Depth	1.3 ft
Discharge	27.815 cfs
Velocity	0.95 fps
Pools rated 1,2,3	42% sample
Habitat	67% optimum

Scale:
Horizontal 1" = 2.84 ft
Vertical 1" = 1 ft

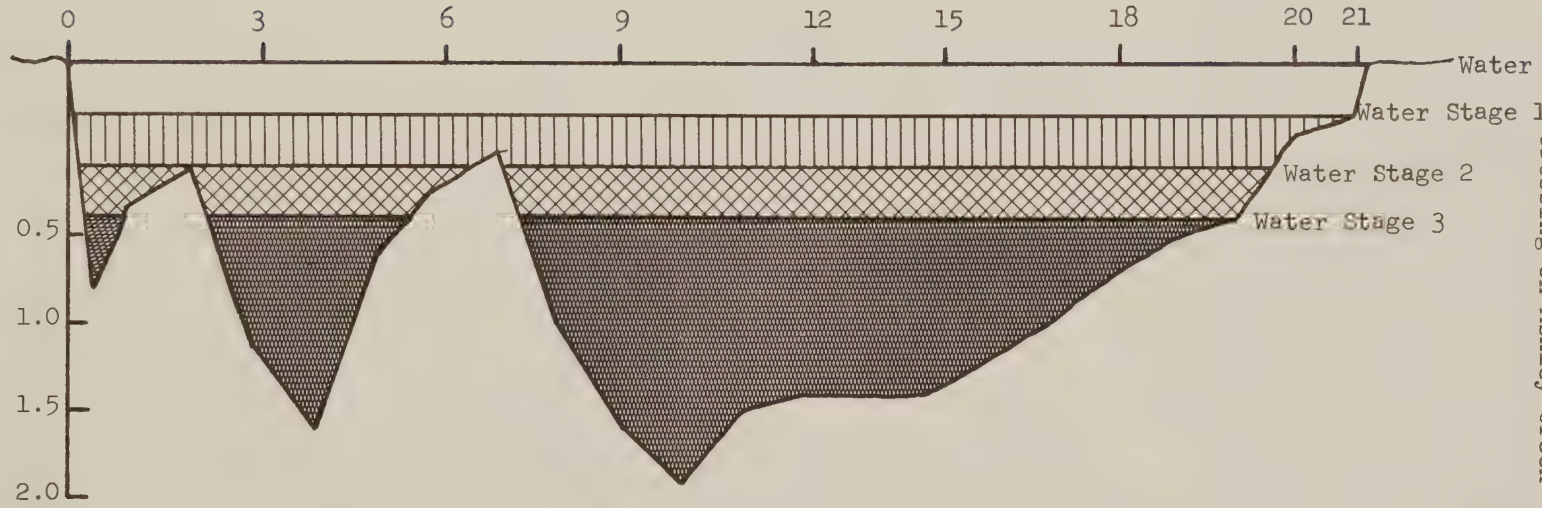


Figure 46
ASHLEY CREEK
Station #4 - 1/4 mile
below sheep trail
crossing on Ashley Creek

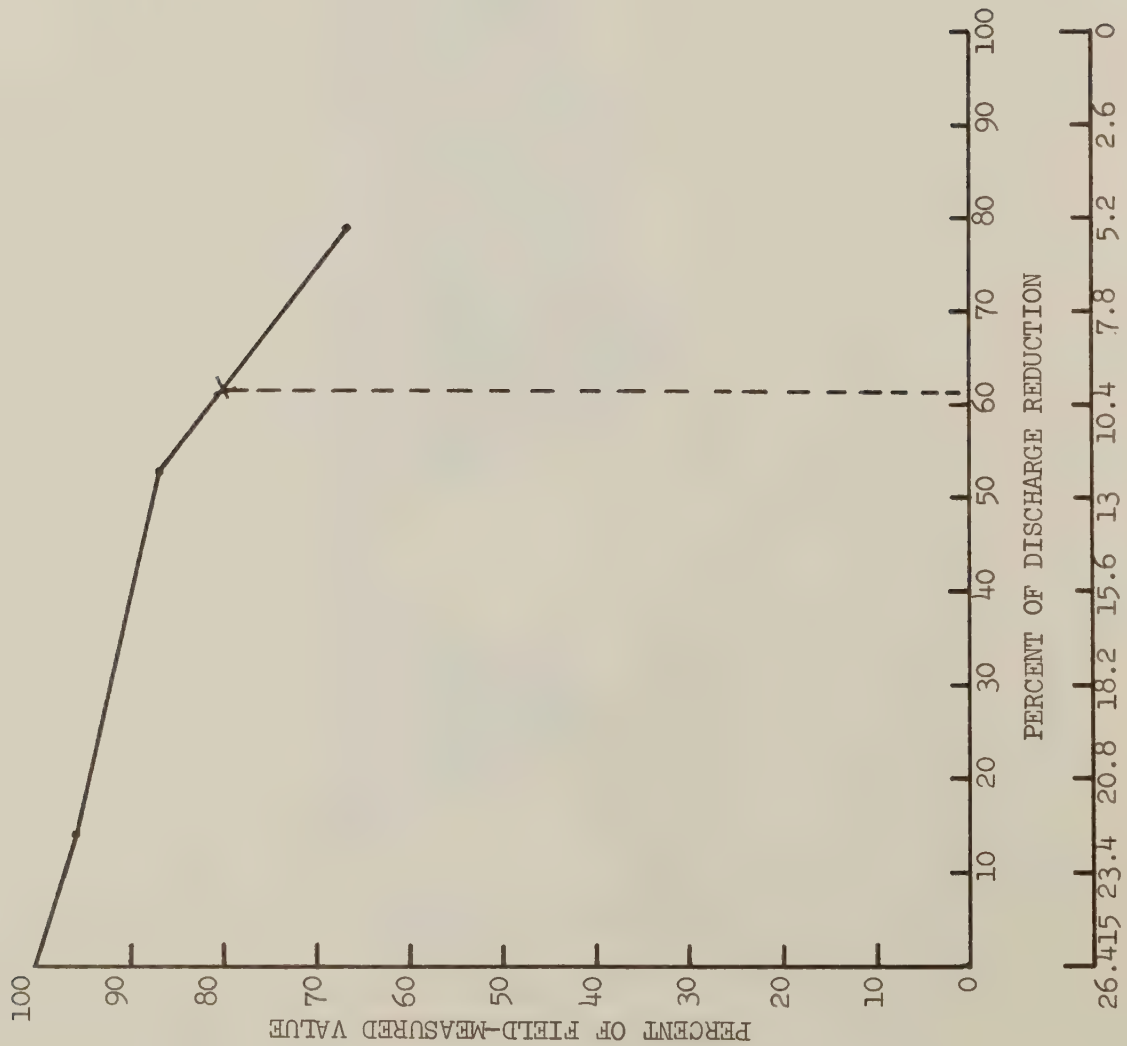
Water Stage	Discharge	%	Velocity	%	Max. Depth	%	Ave. Depth	%	Area	%	Water Surface	%	Wetted Perimeter	%	Habitat Retained	%
0	27.815 cfs	100	0.95 fps	100	2.4 ft	100	1.3 ft	100	29.16 sqft	100	21.0 ft	100	26.0 ft	100	67% opt	100
1	18.40 cfs	66	0.81 fps	85	1.9 ft	79	1.1 ft	85	22.72 sqft	78	20.9 ft	100	25.4 ft	98	62% opt	93
2	12.067 cfs	43	0.72 fps	76	1.8 ft	75	0.9 ft	69	16.76 sqft	58	18.7 ft	89	22.6 ft	87	55% opt	82
3	8.197 cfs	30	0.69 fps	73	1.5 ft	63	0.6 ft	55	11.88 sqft	41	15.1 ft	72	17.0 ft	65	48% opt	71

Station 1, Ashley Creek

Retention of aquatic habitat characteristics at 80 percent of measured values can be attained with a 62 percent reduction of the base-measured flow of about 26 cfs to 10 cfs as illustrated in Figure 47. Streambottom and channel features at a reduced flow of 10 cfs can be compared with three water level stages as illustrated in Figure 48. Flows below Stations 4 and 1 indicate a general increase in discharge would occur. This gain may also be influenced by existing upstream reservoirs.

Figure 47
ASHLEY CREEK
Station #1 - 1/4 mile below Ashley Trails
and 1/2 mile above Red Pine Creek

100% of Field-Measured Values	
Water Surface	21.5 ft
Wetted Perimeter	25.1 ft
Maximum Depth	1.9 ft
Average Depth	0.8 ft
Discharge	26.415 cfs
Velocity	1.79 fps
Pools rated 1,2,3	86% sample
Habitat	36% optimum



Scale:
Horizontal 1" = 2.84 ft
Vertical 1" = 1 ft

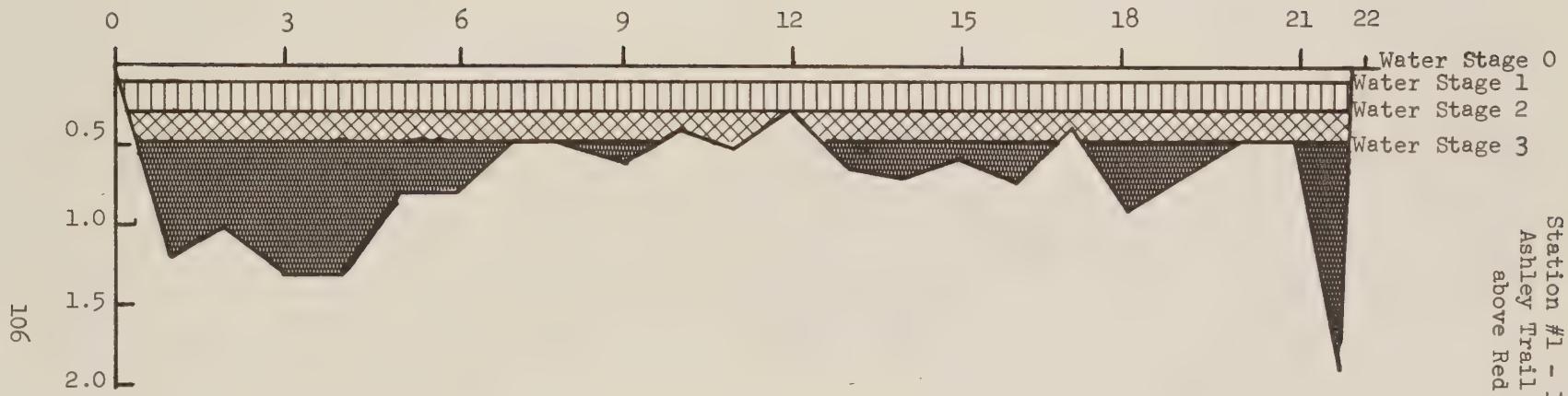


Figure 48
ASHLEY CREEK
Station #1 - 1/4 mile below
Ashley Trail and 1/2 mile
above Red Pine Creek

Water Stage	Discharge	%	Velocity	%	Max. Depth	%	Ave. Depth	%	Area	%	Water Surface	%	Wetted Perimeter	%	Habitat Retained	%
0	26.415 cfs	100	1.79 fps	100	1.9 ft	100	0.8 ft	100	14.75 sqft	100	21.5 ft	100	25.1 ft	100	36% opt	100
1	22.71 cfs	86	1.69 fps	94	1.8 ft	95	0.7 ft	88	13.44 sqft	91	21.4 ft	100	24.9 ft	99	35% opt	96
2	12.34 cfs	47	1.33 fps	74	1.6 ft	84	0.5 ft	63	9.28 sqft	63	21.2 ft	99	24.5 ft	98	31% opt	87
3	5.47 cfs	21	1.3 fps	58	1.4 ft	74	0.3 ft	38	5.32 sqft	36	17.3 ft	80	20.5 ft	82	23% opt	67

Station 1A, Ashley Creek

The base flow discharge measurement above Red Pine Creek of 15 cfs could be reduced to a minimum of 4 cfs and still retain about 81 percent of the habitat characteristics. This reduction in flow would approximate about 75 percent of the base flow. Flows between Station 1 and 1A indicate a slight loss between these two stations. Habitat losses would be acceptable at this flow because of the gradual decrease in habitat characteristics, Figure 49. Streambottom characteristics at three water stages below the base flow of 15 cfs are shown in Figure 50.

Figure 49
ASHLEY CREEK
Station #1A - above Red Creek Draw

SCALE:
Horizontal 1" = 2 ft
Vertical 1" = 1 ft

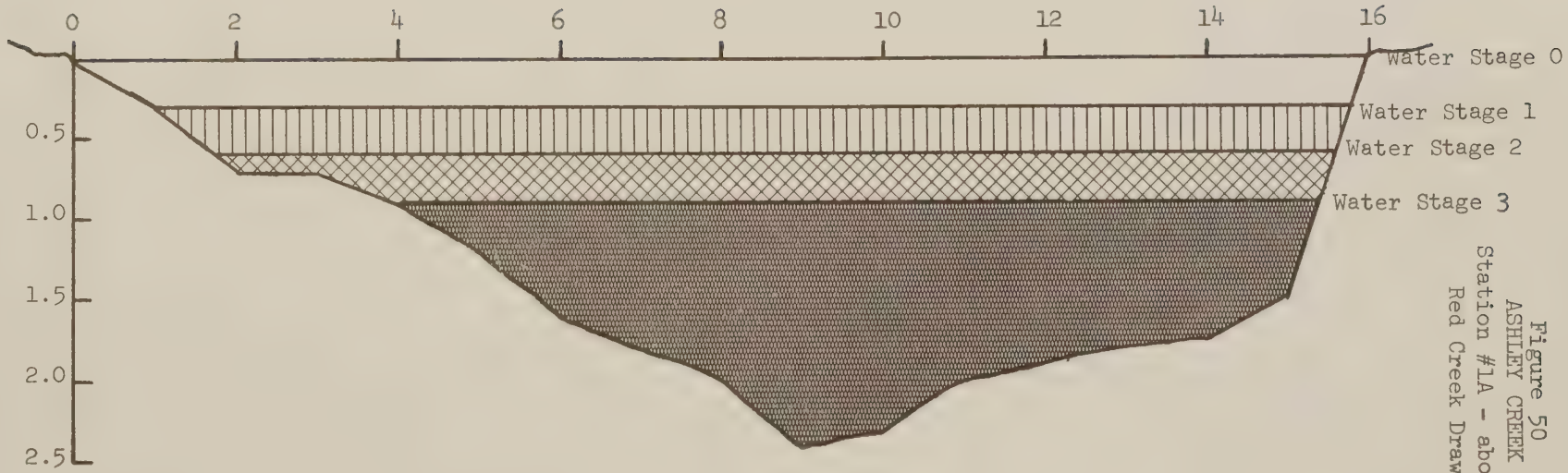


Figure 50
ASHLEY CREEK
Station #1A - above
Red Creek Draw

Water Stage	Discharge	%	Velocity	%	Max. Depth	%	Ave. Depth	%	Area	%	Water Surface	%	Wetted Perimeter	%	Habitat Retained	%
0	15.090 cfs	100	0.74 fps	100	2.4 ft	100	1.2 ft	100	20.33 sqft	100	15.1 ft	100	37.9 ft	100	67% opt	100
1	9.828 cfs	65	0.63 fps	85	2.1 ft	88	1.0 ft	83	15.60 sqft	77	14.7 ft	97	37.1 ft	98	62% opt	93
2	3.732 cfs	25	0.43 fps	58	1.8 ft	75	0.7 ft	58	8.68 sqft	43	13.6 ft	90	35.8 ft	94	54% opt	81
3	3.233 cfs	21	0.43 fps	58	1.5 ft	63	0.6 ft	50	7.52 sqft	37	9.0 ft	60	31.0 ft	82	43% opt	64

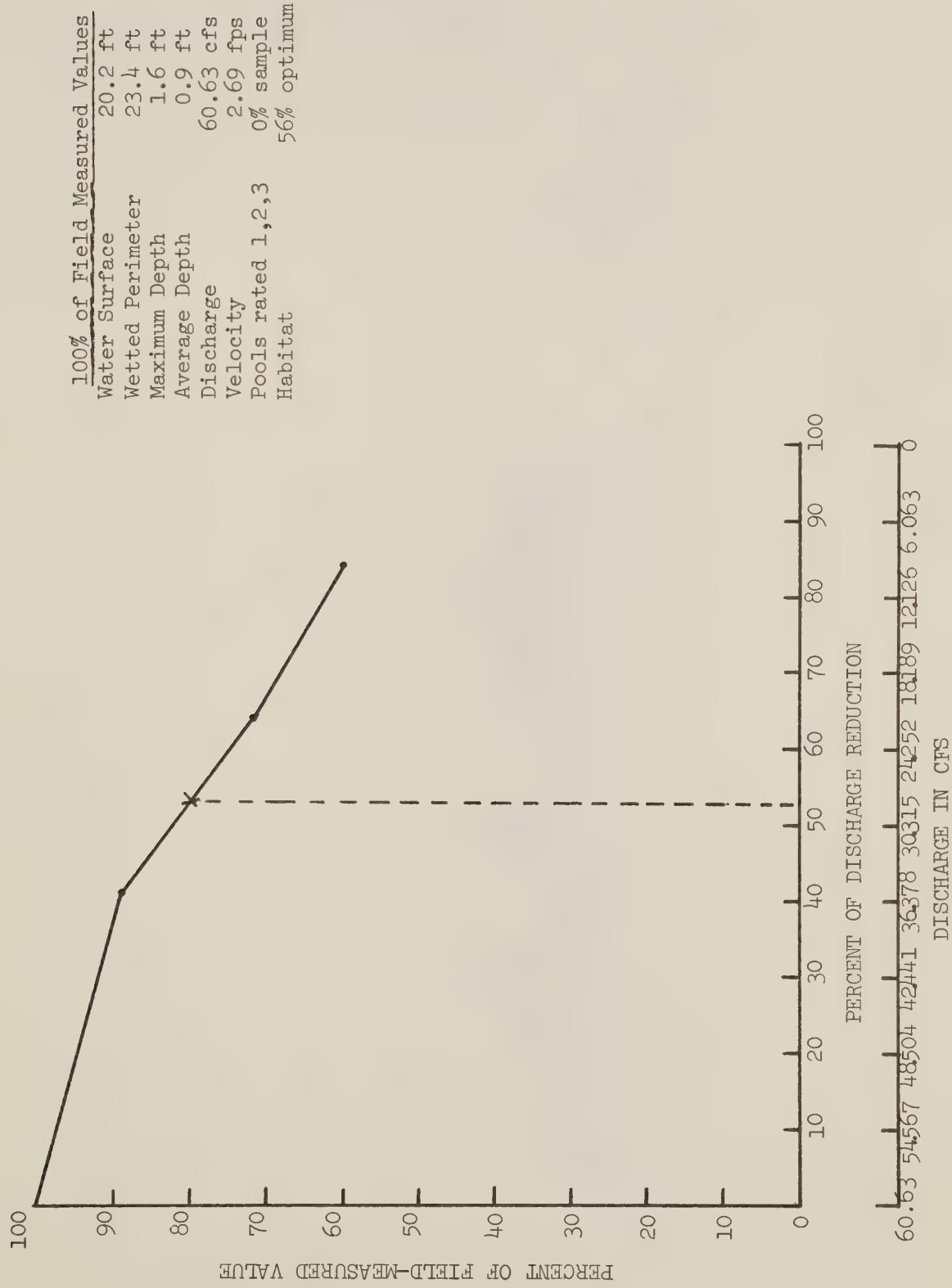
Station 1B, Ashley Creek

No recommendation is made for flows at this station located on Cow Hollow Creek. The flow is intermittent and was reported dry in 1963. Some flows were observed in 1964 and 1965.

Station 3, Ashley Creek

The base-measured flow of about 61 cfs just below the Forest boundary could be reduced to 28 cfs. The habitat trend-discharge relationship begins to drop very quickly at a reduced flow of 41 percent of the measured discharge. Habitat retention at 80 percent of the measured field characteristics would require a minimum flow of 28 cfs at this point, Figure 51. The flow of 28 cfs at this station would be dependent on regulated accretion flows above this point on Ashley Creek and flows presently diverted from Brush Creek into Ashley basin. Stream channel bottom features in relation to three discharge reductions from the base-measured flow of about 61 cfs is illustrated in Figure 52.

Figure 51
ASHLEY CREEK
Station #3 - 1-1/2 miles above Vernal City Water Supply spring and opposite 2 Pt. Rocks on east side of creek



Scale:
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Vertical 1" = 1 ft

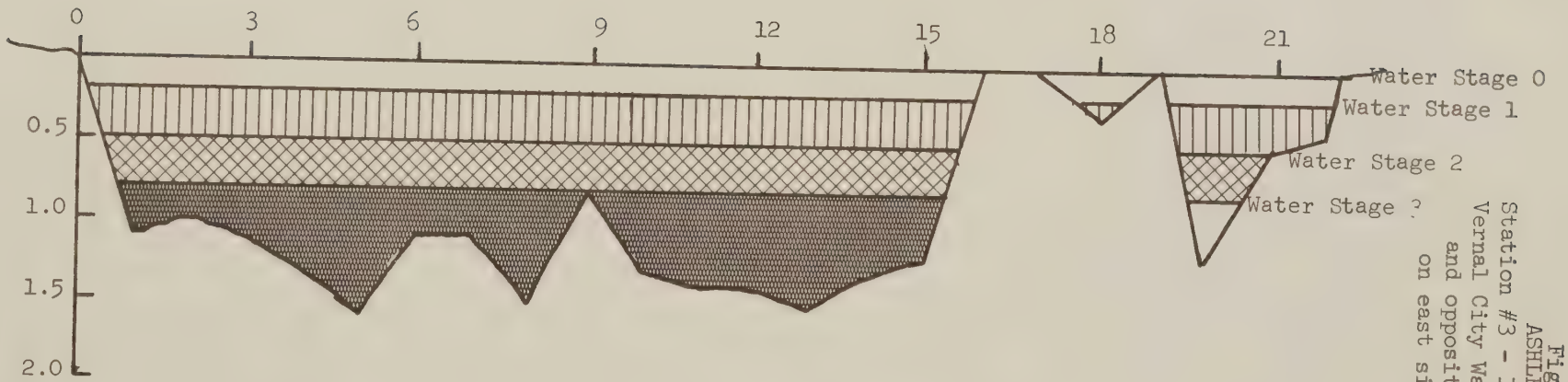


Figure 52
ASHLEY CREEK
Station #3 - 1-1/2 miles above Vernal City Water Supply spring and opposite 2 Pt. Rocks on east side of creek

Water Stage	Discharge	%	Velocity	%	Max. Depth	%	Ave. Depth	%	Area	%	Water Surface	%	Wetted Perimeter	%	Habitat Retained	%
0	60.63 cfs	100	2.69 fps	100	1.6 ft	100	0.9 ft	100	22.55 sqft	100	20.2 ft	100	23.4 ft	100	56% opt	100
1	35.910 cfs	59	2.25 fps	84	1.4 ft	88	0.7 ft	78	15.96 sqft	71	19.2 ft	95	21.7 ft	93	50% opt	89
2	22.02 cfs	36	1.98 fps	74	1.1 ft	69	0.5 ft	56	11.12 sqft	49	16.3 ft	81	18.2 ft	78	40% opt	72
3	9.96 cfs	16	1.50 fps	56	0.8 ft	50	0.3 ft	33	6.64 sqft	29	15.1 ft	75	16.6 ft	71	24% opt	60

A comparison of the 28 cfs flow to the historic average monthly flow at USGS gage 9-2665 is shown in Figure 53.

The flow duration curve for USGS gage 9-2665 indicates a flow of 28 cfs would be achieved approximately 76 percent of the time. Since the flow in Ashley Creek is partly regulated by several upstream reservoirs, an adjusted release pattern could possibly sustain a greater percentage for the indicated flow as shown in Figure 54.

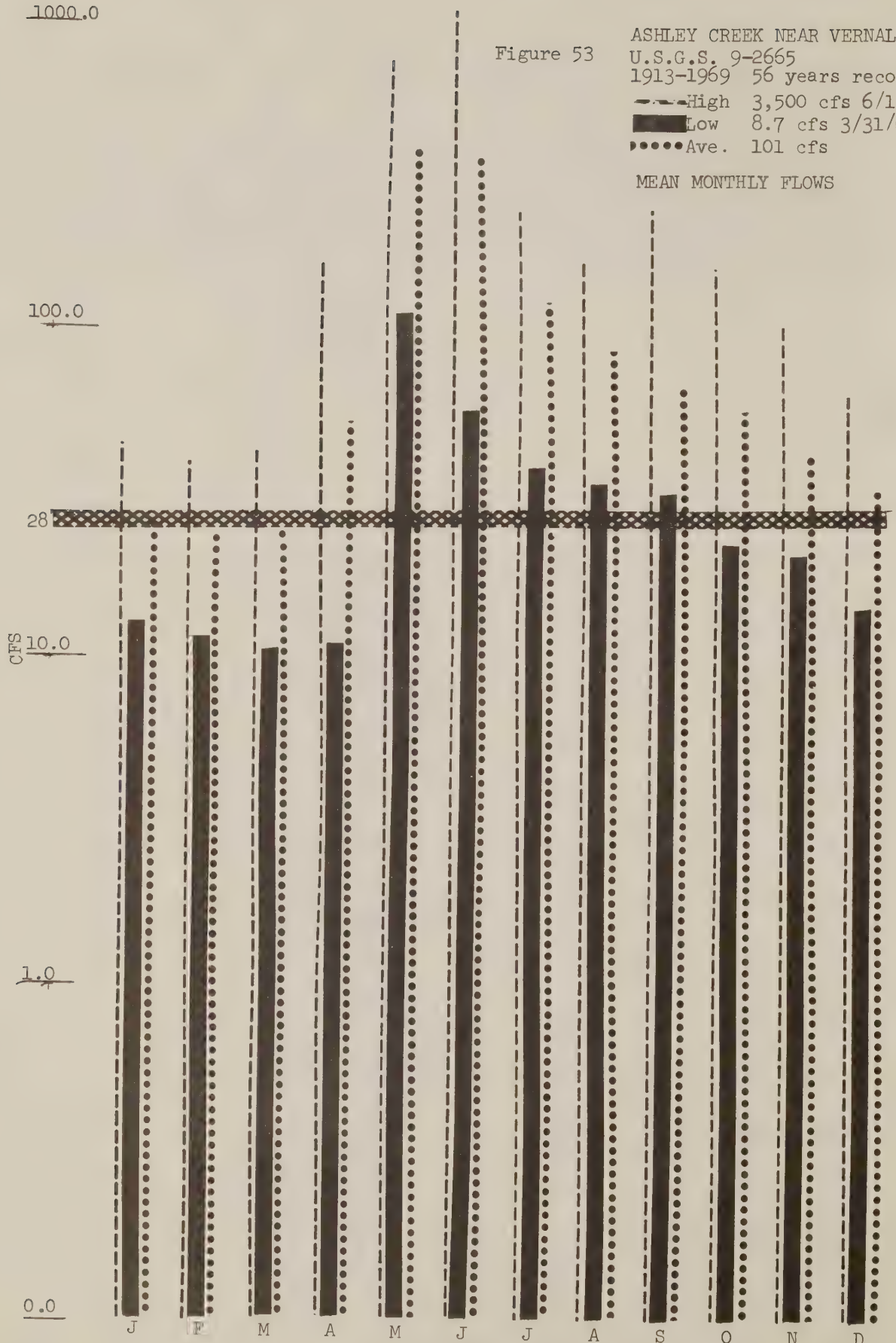


Figure 53

ASHLEY CREEK NEAR VERNAL
U.S.G.S. 9-2665
1913-1969 56 years record
High 3,500 cfs 6/11/65
Low 8.7 cfs 3/31/67
Ave. 101 cfs

MEAN MONTHLY FLOWS

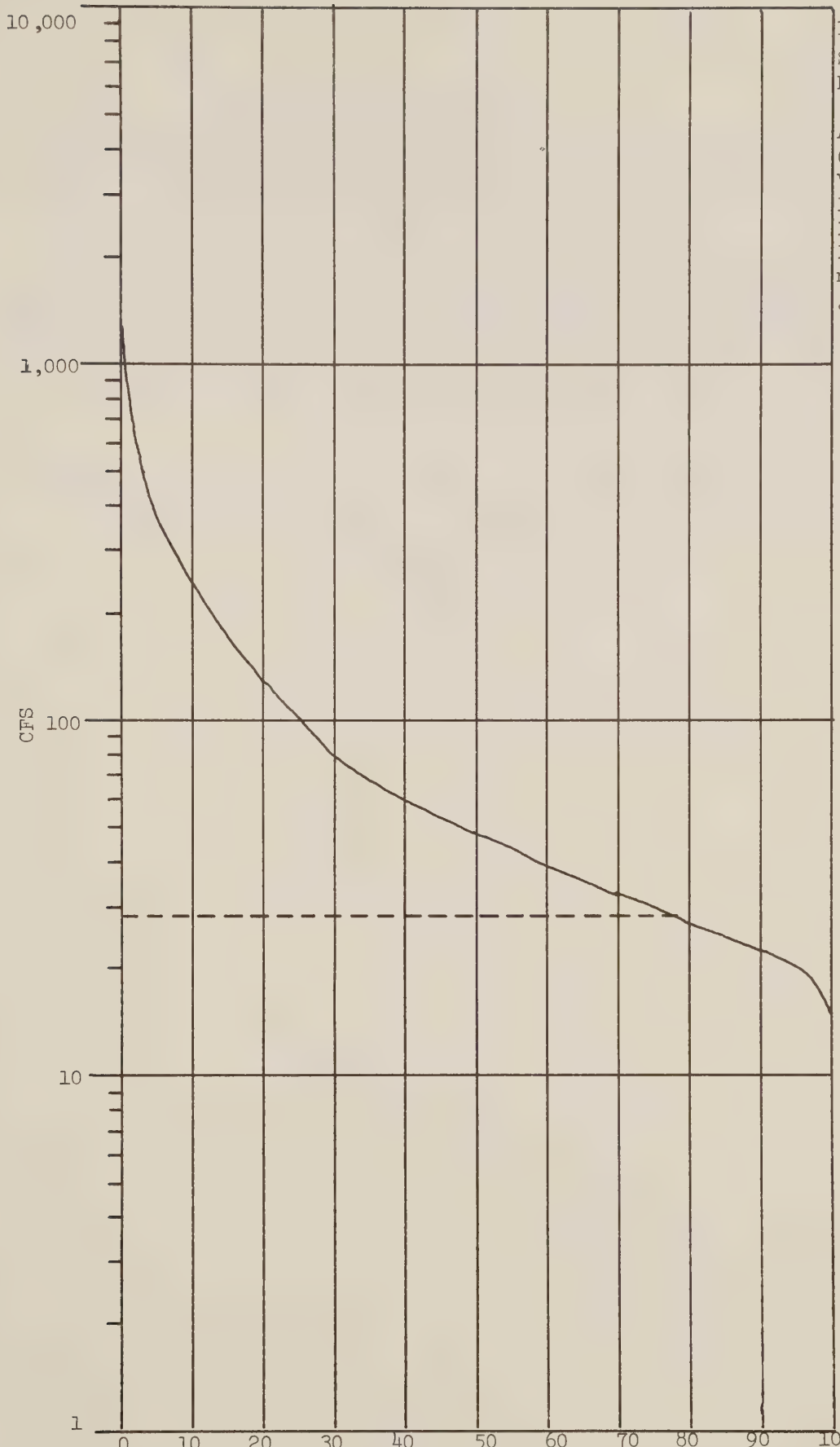


Figure 54
Station
No. 2665

Ashley
Creek near
Vernal, Ut.
1916, 1920
1922-27,
1930-57,
not ad-
justed.

Dry Fork

The proposed Dry Fork Reservoir would serve as a storage point for winter and spring flows. The water would then be transported through the proposed Uintah Aqueduct to the Bonneville Basin.

Dry Fork is an intermittent stream with water losses at various points because of existing sinks in the streambed. Electrofishing surveys have not been made although the stream is reported to sustain a fair fishery where water flows are present.

Little use is made of the stream because of difficult access into the area.

The Forest Service makes no recommendation for Dry Fork because of the intermittent flow, difficult access, and nonclassification of the stream in the State Fishing Waters Inventory.

East Fork of Dry Fork (Brownie Canyon)

A proposed diversion dam on East Fork of Dry Fork will convey waters to the Uintah Aqueduct. A survey of East Fork in 1963 indicated the stream sinks into the streambed below the planned diversion point and is dry below the station.

No further studies were made. A recommended release below the proposed diversion point is not comtemplated because of the intermittent flow and presence of sinks below the diversion point which dry up sections of the streambed.

Whiterocks River

The proposed Lake Ashley Reservoir will require two earth dams. One dam will be about 0.5 mile above the confluence of the tributary from Chepeta Lake. The other dam will be on the tributary from Whiterocks Lake.

Several tributaries between the proposed damsite and the proposed Uintah Aqueduct probably have accretion flows sufficient to sustain the fisheries in this section of the river. No studies have been conducted for this portion of the river.

One study station was established below the proposed Uintah Aqueduct to determine flows necessary to retain aquatic habitat downstream to the Whiterocks Reservoir.

Station 1A, Whiterocks River

The base-measured flow of about 46 cfs above Lilly Lake tributary could be reduced approximately 56 percent to a flow of 20 cfs which would retain 80 percent of measured habitat characteristics. Aquatic habitat features drop sharply below this point as shown in Figure 55. Habitat losses associated with three discharge reductions below the base-measured flow of 46 cfs are illustrated in Figure 56. The recommended release of 20 cfs below the proposed Uintah Aqueduct can be compared with the various stream channel features at each water stage.

Figure 55
WHITEROCKS RIVER
Station #1A - above Lily Lake Creek 1/4 mile and
100 yards above west vertical wall by stream

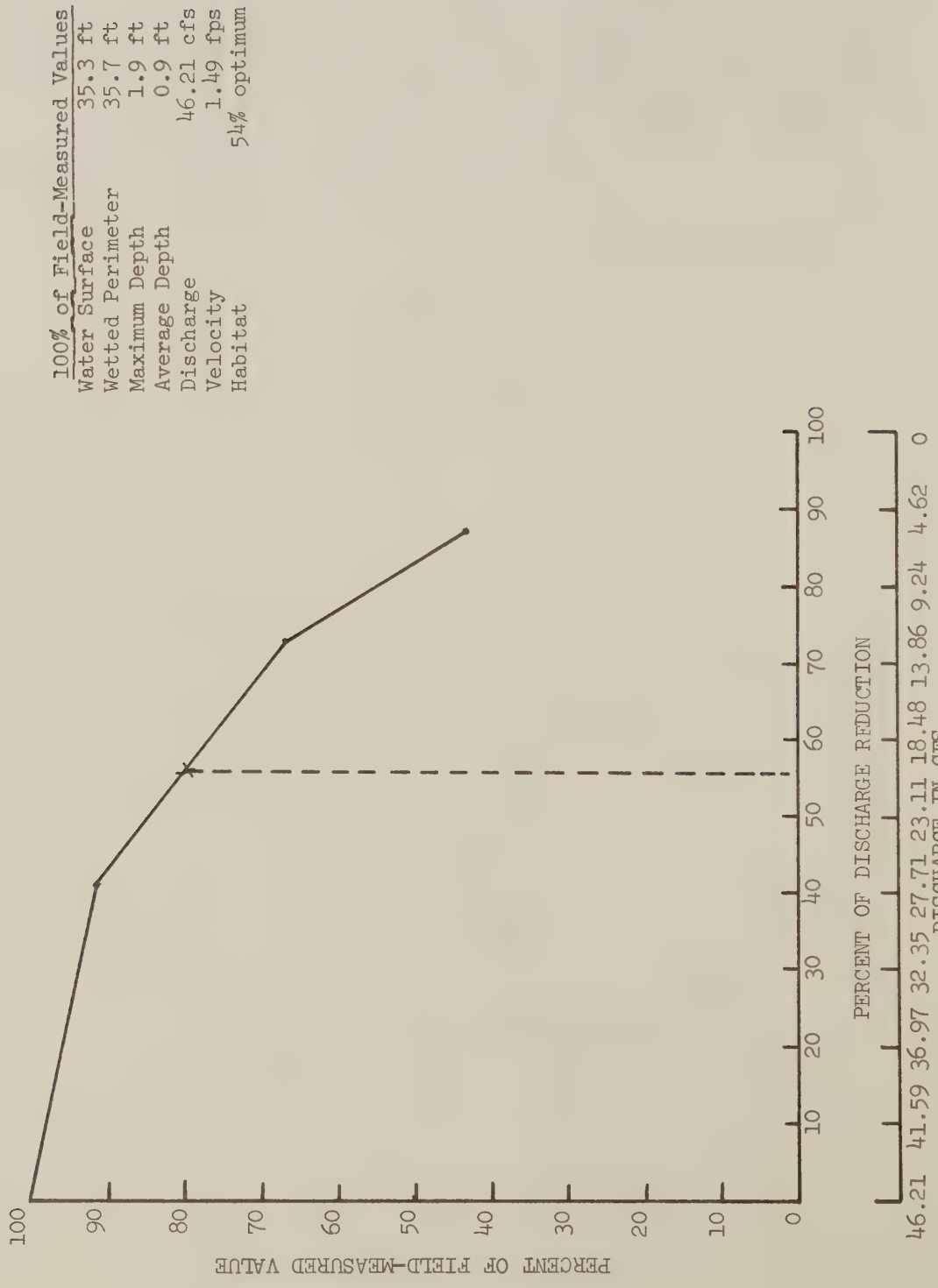
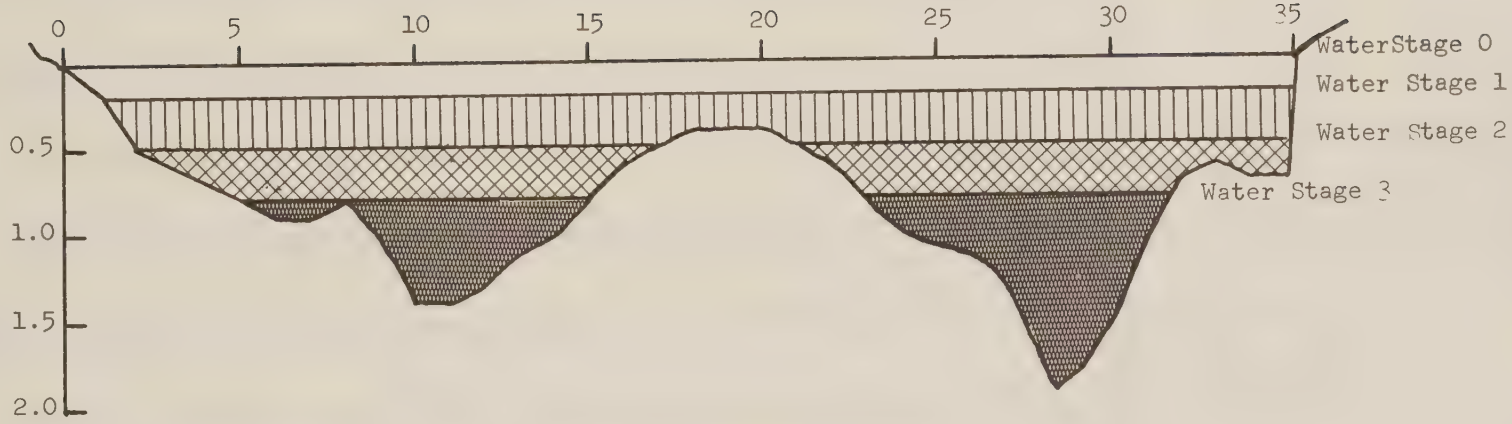


Figure 56
WHITEROCKS RIVER
Station #1A - above Lily Lake
Creek 1/4 mile and 100 yards
above west vertical wall by stream

Scale:
Horizontal 1" = 5 ft
Vertical 1" = 1 ft



Water Stage	Discharge	%	Velocity	%	Max. Depth	%	Ave. Depth	%	Area	%	Water Surface	%	Wetted Perimeter	%	Habitat Retained	%
0	46.21 cfs	100	1.49 fps	100	1.9 ft	100	0.9 ft	100	30.95 sqft	100	35.3 ft	100	35.7 ft	100	54% opt	100
1	27.10 cfs	59	1.21 fps	81	1.7 ft	90	0.7 ft	78	22.40 sqft	72	35.0 ft	99	35.3 ft	99	50% opt	92
2	12.45 cfs	27	0.97 fps	65	1.4 ft	74	0.4 ft	44	12.84 sqft	41	27.0 ft	76	28.4 ft	80	36% opt	67
3	6.04 cfs	13	0.83 fps	56	1.1 ft	58	0.2 ft	22	7.28 sqft	24	18.2 ft	52	20.2 ft	57	24% opt	44

Uinta River

The proposed Burro Dam and Reservoir to be constructed on Shale Creek would store winter and spring waters for transmission into the Uintah Aqueduct. The aqueduct would be located about 9 miles below the reservoir. Downstream aquatic habitat would be affected below the aqueduct diversion unless adequate releases were provided.

Five stations were established below the proposed aqueduct and the proposed Uintah Reservoir associated with the Uintah Phase of the Central Utah Project. The Uinta Reservoir would be constructed below the National Forest boundary and was covered in the Uintah Phase of the report.

Minimum flow recommendations vary at each of the established stations. Gains and losses in the river are reflected in station readings. A release of 40 cfs is recommended below the Uintah Aqueduct to sustain the downstream aquatic habitat and fisheries. A comparison of the recommended release of 40 cfs at this point in the river is shown in relation to the historic flows for USGS gage 9-2960 about 3 miles downstream, Figure 57.

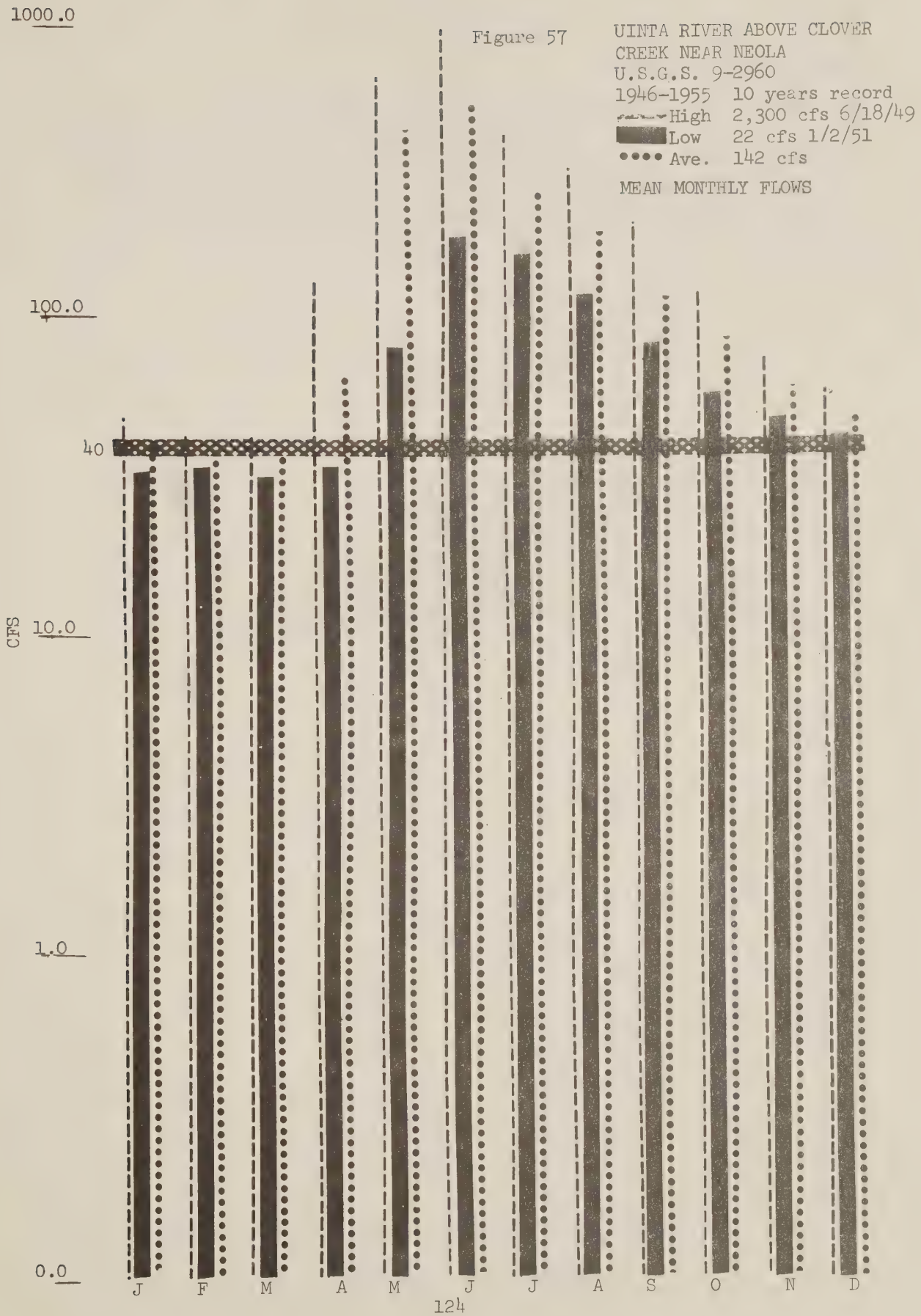


Figure 57

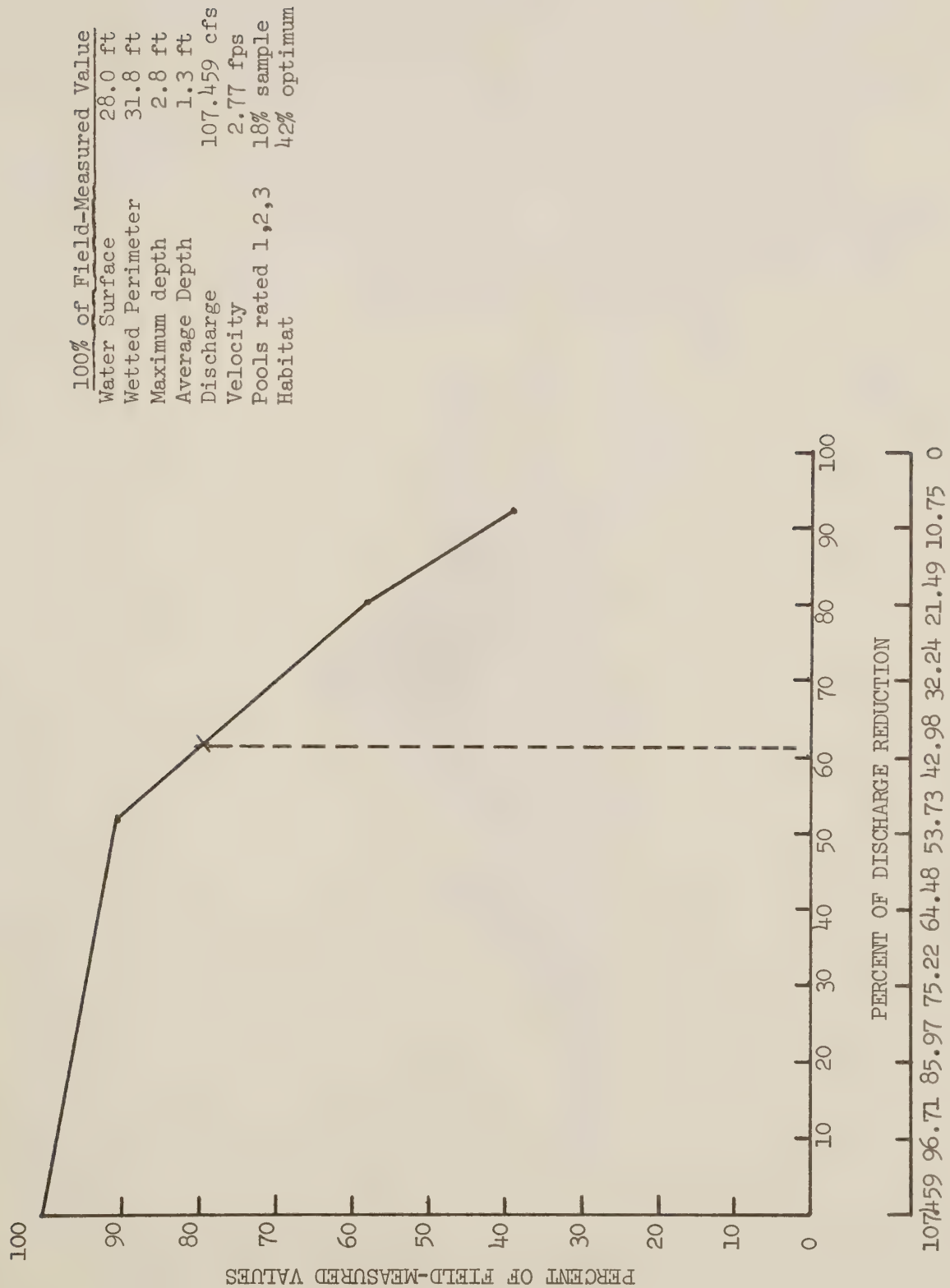
UINTA RIVER ABOVE CLOVER CREEK NEAR NEOLA
U.S.G.S. 9-2960
1946-1955 10 years record
High 2,300 cfs 6/18/49
Low 22 cfs 1/2/51
Ave. 142 cfs

MEAN MONTHLY FLOWS

Station 4, Uinta River

The base-measured flow of about 108 cfs when reduced approximately 61 percent would retain the base objective of at least 80 percent of habitat features at a flow of 40 cfs. Habitat values drop very sharply below this discharge rate as indicated in Figure 58. Streambottom features and habitat losses in comparison with three reduction discharge stages are illustrated in Figure 59.

Figure 58
UINTA RIVER
Station #4 - sheep bridge



Scale:
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Vertical 1" = 1 ft

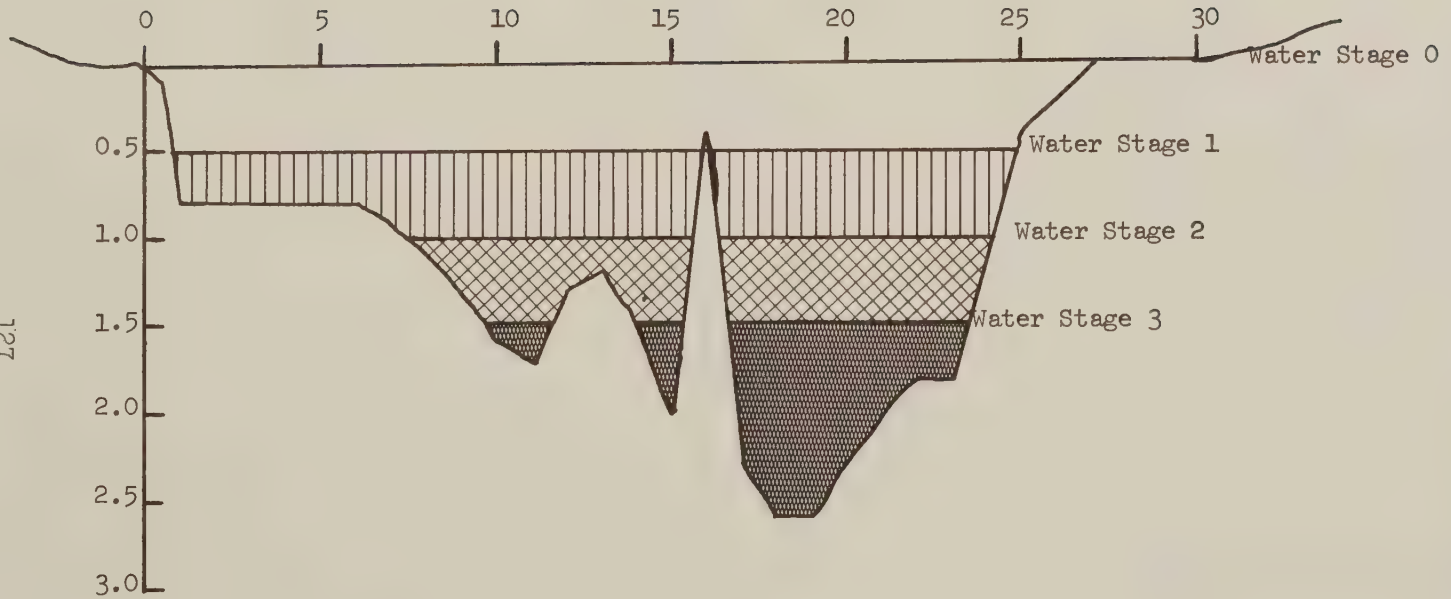


Figure 59
UINTA RIVER
Station #4 - sheep bridge

Water Stage	Discharge	%	Velocity	%	Max. Depth	%	Ave. Depth	%	Area	%	Water Surface	%	Wetted Perimeter	%	Habitat Retained	%
0	107.459 cfs	100	2.77 fps	100	2.8 ft	100	1.3 ft	100	38.73 sqft	100	28.0 ft	100	31.8 ft	100	46% opt	100
1	52.704 cfs	49	2.16 fps	78	2.5 ft	89	0.9 ft	69	24.40 sqft	63	26.1 ft	93	29.6 ft	93	40% opt	86
2	21.716 cfs	20	1.78 fps	64	1.8 ft	64	0.7 ft	54	12.20 sqft	32	16.2 ft	58	19.7 ft	62	23% opt	58
3	8.642 cfs	8	1.45 fps	52	1.3 ft	46	0.4 ft	31	5.96 sqft	15	10.6 ft	38	13.2 ft	42	17% opt	39

Station 1, Uinta River

The base-measured discharge of 126 cfs at this station, when reduced approximately 50 percent, would require a flow of 63 cfs to retain habitat characteristics at 80 percent of the measured field values. Habitat values drop rather sharply below this flow. An absolute minimum flow of 50 cfs at this station could be adequate to sustain the aquatic habitat at the critical point of degradation. Flow measurements indicate a general slight gain between Stations 4 and 1. A release of 40 cfs below the aqueduct diversion would not gain sufficient water to meet the minimum 50 c.f.s. habitat requirement. The habitat trend-dicharge relationship is shown in Figure 60. Comparison of the streambottom features in relation to three reduced water stages from the base flow of 126 cfs is illustrated in Figure 61.

Figure 60
UINTA RIVER
Station #1 - approximately 1 mile downstream from sheep bridge

100% of Field-Measured Values	
Water Surface	40.3 ft
Wetted Perimeter	40.9 ft
Maximum Depth	2.4 ft
Average Depth	1.4 ft
Discharge	126.0 cfs
Velocity	2.27 fps
Pools rated 1,2,3	18% sample
Habitat	55% optimum

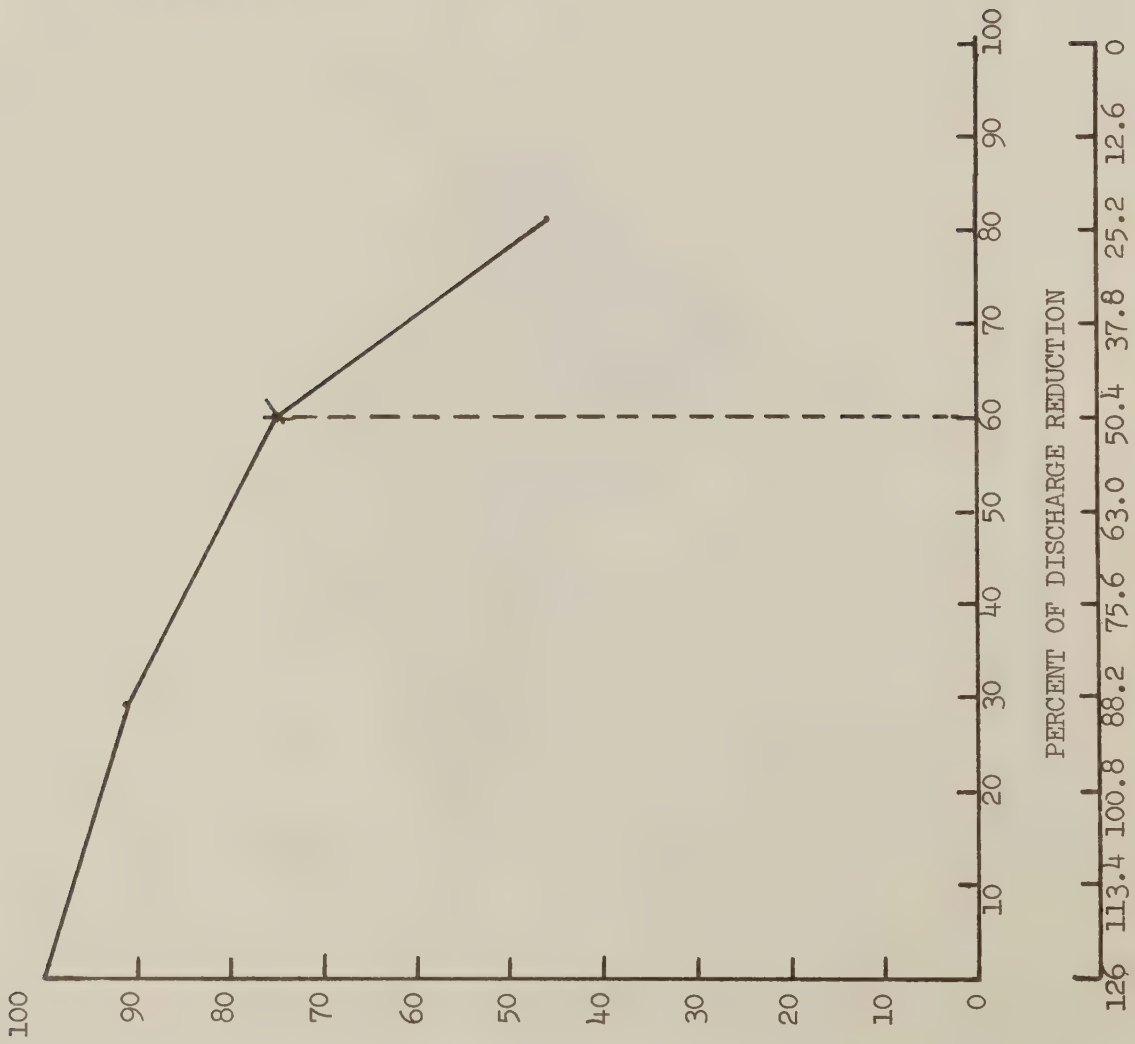


Figure 61
UINTA RIVER
Station #1 - approximately 1 mile downstream from sheep bridge

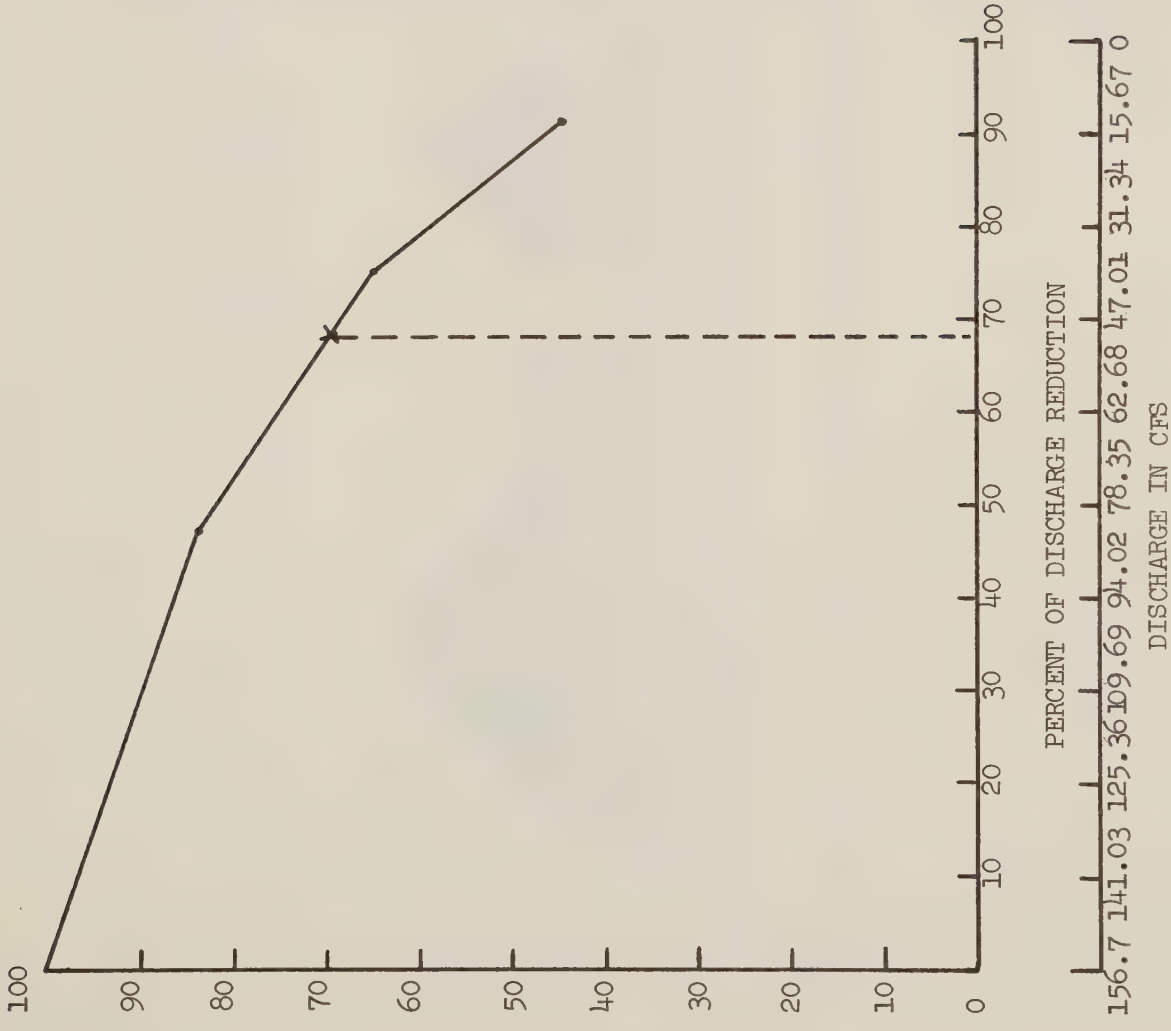
Water Stage	Discharge	%	Velocity	%	Max. Depth	%	Ave. Depth	%	Area	%	Water Surface	%	Wetted Perimeter	%	Habitat Retained	%
0	126.0 cfs	100	2.27 fps	100	2.4 ft	100	1.4 ft	100	55.40 sqft	100	40.3 ft	100	40.9 ft	100	55% opt	100
1	89.72 cfs	71	2.01 fps	89	2.1 ft	88	1.2 ft	86	44.64 sqft	81	38.0 ft	94	38.6 ft	94	50% opt	91
2	50.70 cfs	40	1.69 fps	74	1.7 ft	71	0.9 ft	64	30.0 sqft	54	31.5 ft	78	33.9 ft	83	41% opt	75
3	23.46 cfs	19	1.40 fps	62	1.2 ft	50	0.5 ft	43	16.76 sqft	30	22.7 ft	56	25.2 ft	62	30% opt	54

Station 2, Uinta River

A 53 percent reduction in the base-measured flow of about 157 cfs to approximately 73 cfs would attain the 80 percent habitat retention objective as indicated in Figure 62. Degradation of habitat features occurs rapidly between reductions of 83 cfs and 39 cfs as shown in the stream channel cross section, Figure 63. A minimum flow of 50 cfs representing a 68 percent reduction in the base-measured flow would retain the existing aquatic habitat at a dangerously low recovery level but would be adequate for this stream section. Pool depth would average in excess of 1.5 feet, and average stream depth would be about 0.8 feet. A substantial discharge gain occurs between Stations 1 and 2. The downstream accretion in addition to the 40 cfs release below the Uintah Aqueduct diversion point would exceed the minimum habitat requirement of 50 cfs and almost approach the desirable discharge of 73 cfs at this station.

Figure 62
UINTA RIVER
Station #2 - 100 yards below gage station
and 50 feet below side channel

100% of Field-Measured Values	
Water Surface	40.5 ft
Wetted Perimeter	44.8 ft
Maximum Depth	2.5 ft
Average Depth	1.4 ft
Discharge	156.7 cfs
Velocity	2.70 fps
Pools rated 1,2,3	40% sample
Habitat	42% optimum



Scale:
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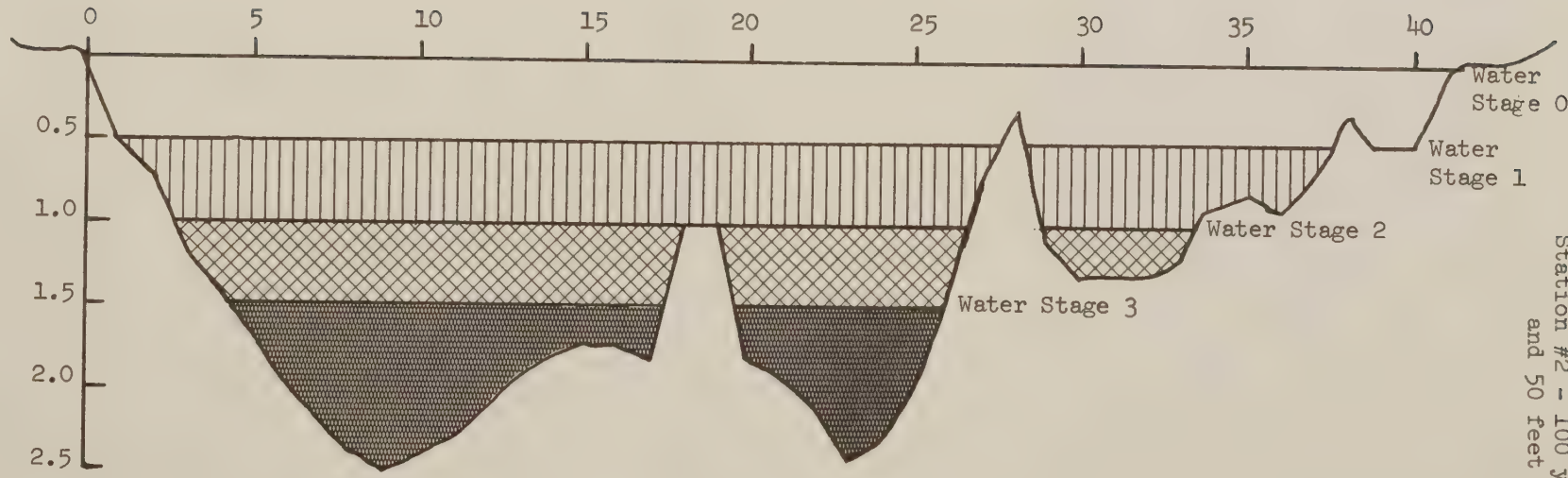
Vertical 1" = 1 ft



Water Stage	Discharge	%	Velocity	%	Max. Depth	%	Ave. Depth	%	Area	%	Water Surface	%	Wetted Perimeter	%	Habitat Retained	%
0	156.7 cfs	100	2.70 fps	100	2.5 ft	100	1.4 ft	100	57.84 sqft	100	40.5 ft	100	44.8 ft	100	42% opt	100
1	82.69 cfs	53	2.19 fps	81	2.0 ft	80	1.0 ft	71	37.76 sqft	65	36.4 ft	90	40.2 ft	90	35% opt	84
2	39.20 cfs	25	1.75 fps	65	1.5 ft	60	0.7 ft	50	22.40 sqft	39	28.9 ft	71	33.3 ft	74	27% opt	65
3	13.36 cfs	0.9	1.31 fps	49	1.0 ft	40	0.5 ft	36	10.20 sqft	18	19.2 ft	47	23.6 ft	53	17% opt	45

Figure 63
UINTA RIVER
Station #2 - 100 yards below gage station and 50 feet below side channel

Station 5, Uinta River

The habitat trend-discharge relationship indicates a discharge reduction of about 44 percent from the base-measured flow of about 54 cfs would provide 80 percent retention of the habitat characteristics at 30 cfs Figure 64. Habitat degradation is generally on a uniform descending scale as indicated in the graph relationship. A minimum flow of 24 cfs representing a reduction of 55 percent of the base-measured flow could probably sustain the aquatic habitat in this portion of the river just above the Forest boundary. Pool depths would likely exceed 1 foot in depth and about 0.5 foot in average depth. A comparison of the base-measured flow of 54 cfs reduced to three water stages illustrates streambottom features at each water level, Figure 65. The flow just above Station 5 is affected by the existing Uintah Powerplant diversion ditch. As proposed in the operation plan, flows at Station 5 would be enhanced through elimination of the Uintah Powerplant. Increased flows would occur at Station 5 and a fishery retained in the existing diversion canal as previously covered under the Uintah Phase.

Figure 64
UINTA RIVER
Station #5 - 3/4 mile above Forest boundary below Big Spring

100% of Field-Measured Values	
Water Surface	26.4 ft
Wetted Perimeter	27.3 ft
Maximum Depth	1.6 ft
Average Depth	0.9 ft
Discharge	54.33 cfs
Velocity	2.14 fps
Pools rated 1,2,3	36% sample
Habitat	56% optimum

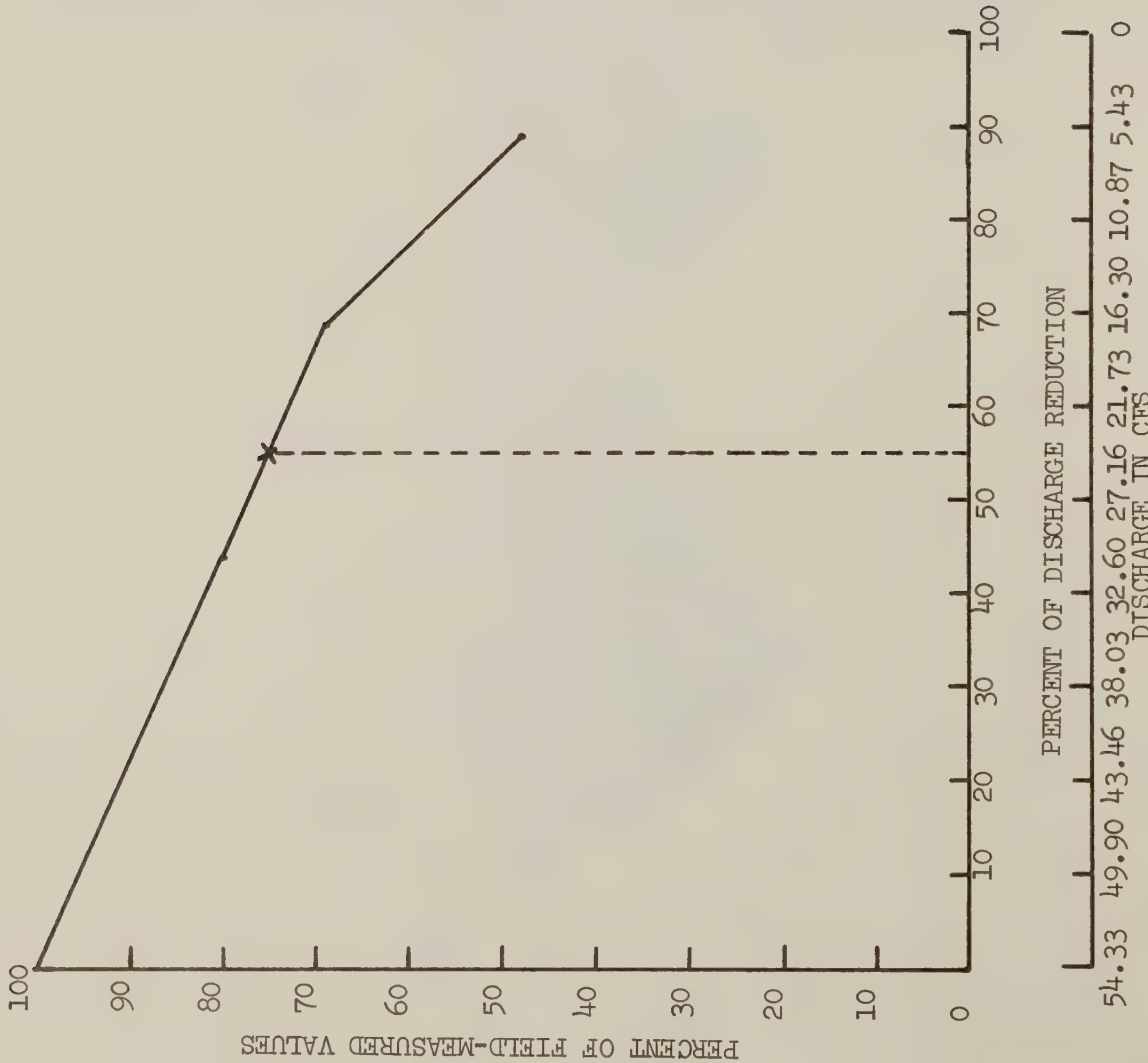


Figure 65
UINTA RIVER
Station #5 - 3/4 mile above Forest boundary below Big Spring

Scale:
Horizontal 1" = 5 ft
Vertical 1" = 1 ft

Water Stage	Discharge	%	Velocity	%	Max. Depth	%	Ave. Depth	%	Area	%	Water Surface	%	Wetted Perimeter	%	Habitat Retained	%
0	54.33 cfs	100	2.14 fps	100	1.6 ft	100	0.9 ft	100	25.35 sqft	100	26.4 ft	100	27.3 ft	100	56% opt	100
1	30.28 cfs	56	1.82 fps	85	1.3 ft	81	0.7 ft	78	16.64 sqft	66	21.6 ft	82	22.2 ft	81	45% opt	80
2	16.92 cfs	31	1.49 fps	70	1.0 ft	63	0.5 ft	56	11.36 sqft	45	20.0 ft	76	20.4 ft	75	39% opt	69
3	6.08 cfs	11	1.11 fps	52	0.7 ft	44	0.3 ft	33	5.48 sqft	22	14.5 ft	55	15.3 ft	56	27% opt	48

Yellowstone River

The proposed Tawanta Dam and Reservoir will eliminate about 2 miles of fisheries in Yellowstone River. Winter and high spring waters would be stored for transmission through the Uintah Aqueduct to the Bonneville Basin. The proposed aqueduct could be immediately below the reservoir or it could empty into the reservoir. Whatever plan is adopted, a minimum stream release should be made to sustain the downstream aquatic habitat to the proposed Boneta Diversion Dam of the Upalco Unit.

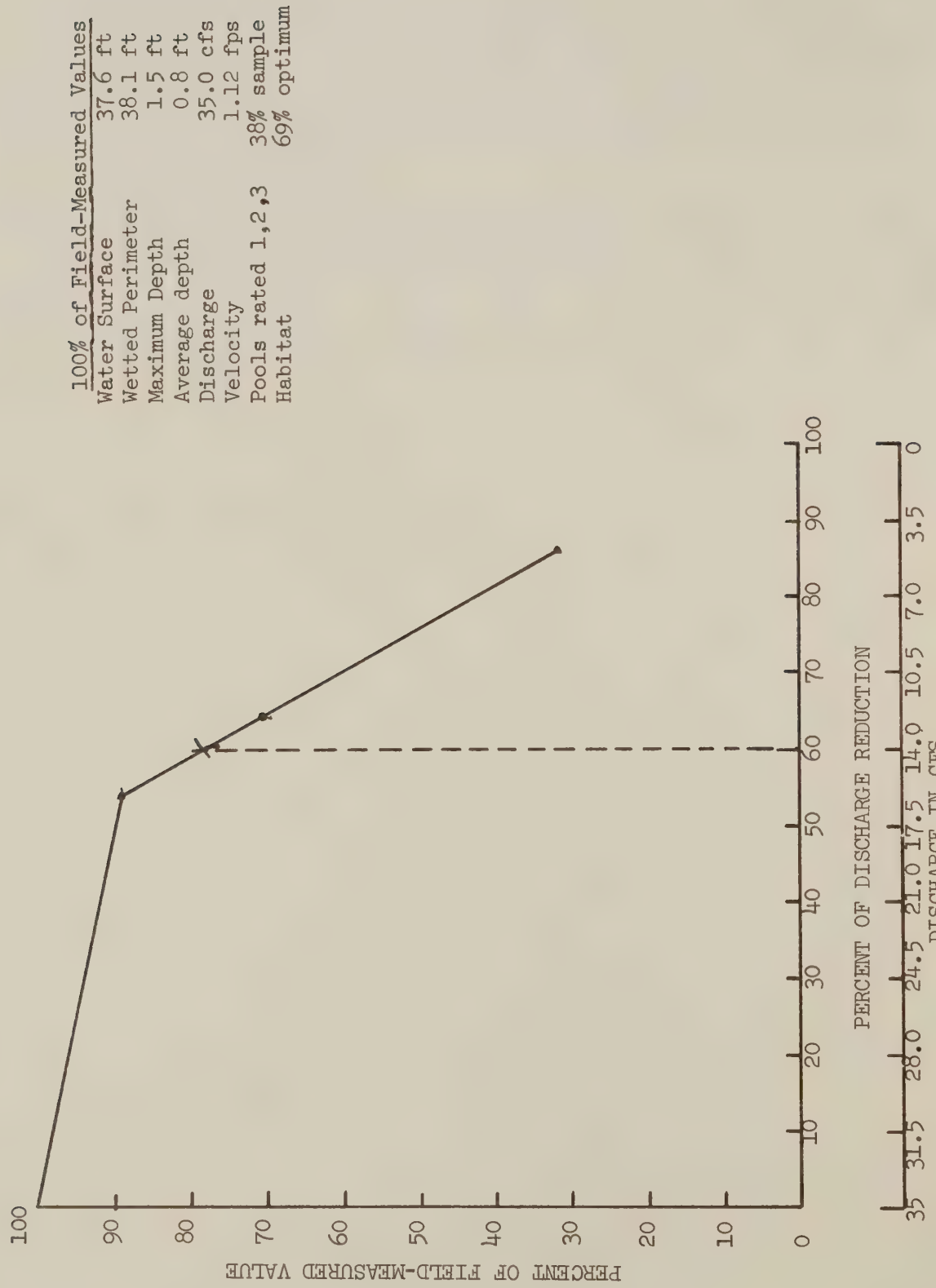
A minimum release of 14 cfs is recommended below the aqueduct or the Tawanta Dam to sustain the aquatic habitat and excellent fisheries in this section of the stream. Accretion flows below Swift Creek would be sufficient to sustain the habitat and fisheries in the stream section above the Boneta Diversion Dam.

Station 5, Yellowstone River

The habitat trend-discharge relationship begins to drop very sharply when the base-measured flow of 35 cfs is reduced approximately 54 percent to a flow of 16 cfs, Figure 66. A recommended release of 14 cfs below the Uintah Aqueduct or from the proposed Tawanta Dam and Reservoir would retain approximately 80 percent of the measured field habitat characteristics at a reduced flow of 60 percent of the base-measured discharge.

Comparison of the 14 cfs release with streambottom features is shown in the stream channel cross section, Figure 67. The maximum pool depth would exceed slightly 1 foot with an average depth of about 0.5 foot.

Figure 66
YELLOWSTONE RIVER
STATION #5 - above Swift Creek



Scale:
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Vertical 1" = 1 ft

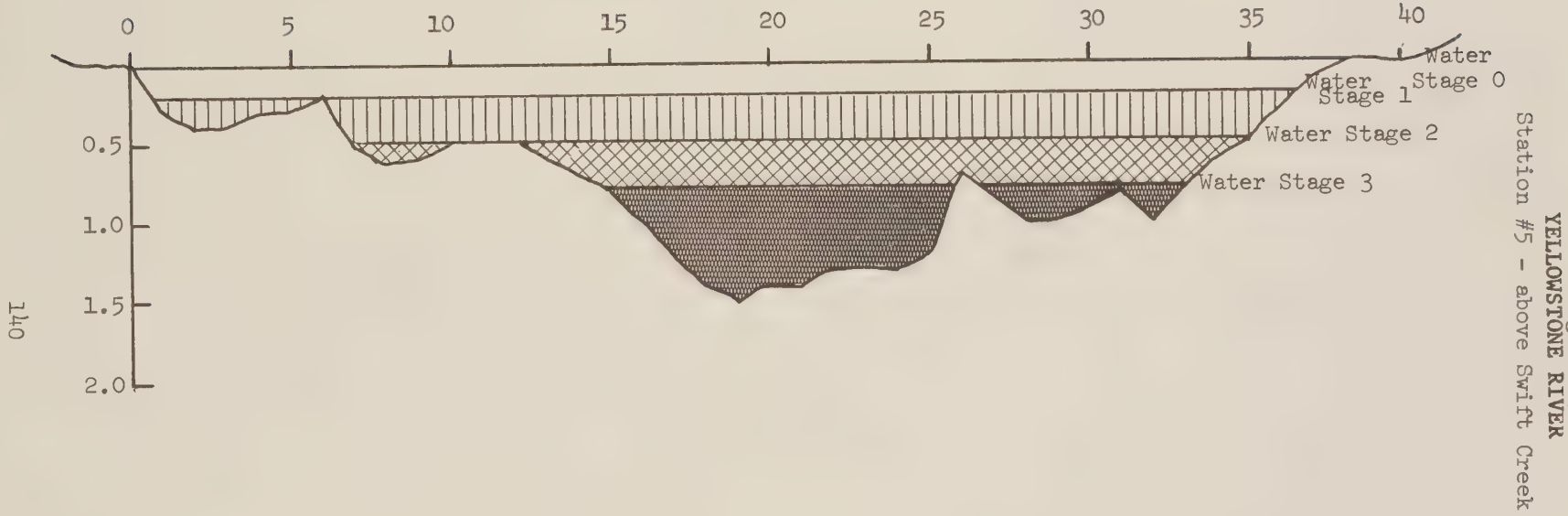

Figure 67
YELLOWSTONE RIVER
Station #5 - above Swift Creek

Water Stage	Discharge	%	Velocity	%	Max. Depth	%	Ave. Depth	%	Area	%	Water Surface	%	Wetted Perimeter	%	Habitat Retained	%
0	35.00 cfs	100	1.12 fps	100	1.5 ft	100	0.8 ft	100	31.13 sqft	100	37.6 ft	100	38.1 ft	100	69% opt	100
1	16.06 cfs	46	0.84 fps	75	1.3 ft	87	0.6 ft	75	19.12 sqft	61	36.6 ft	97	36.1 ft	95	61% opt	89
2	12.57 cfs	36	0.84 fps	75	1.0 ft	67	0.5 ft	63	14.96 sqft	48	28.6 ft	76	28.3 ft	74	49% opt	71
3	4.99 cfs	14	0.66 fps	66	0.7 ft	47	0.4 ft	50	7.56 sqft	24	19.4 ft	52	20.6 ft	54	36% opt	32

Station 3A, Yellowstone River

The base-measured flow of about 77 cfs at this station includes accretion flows from Swift Creek. Aquatic habitat retention of field-measured characteristics at the 80 percent objective would require approximately 36 cfs below this stream section as indicated in Figure 68. The accretion flows in addition to the recommended 14 cfs release below the proposed Tawanta Dam or aqueduct would exceed the recommended minimum flow at this station resulting in enhancement of the fishery. Streambottom features at three reduced water stages from the base measured flow of 77 cfs is shown in Figure 69.

Figure 68
YELLOWSTONE **RIVER**
Station #3A - 1/8 mile below Swift Creek Campground

Scale:
Horiztonal 1" = 5 ft
Vertical 1" = 1 ft

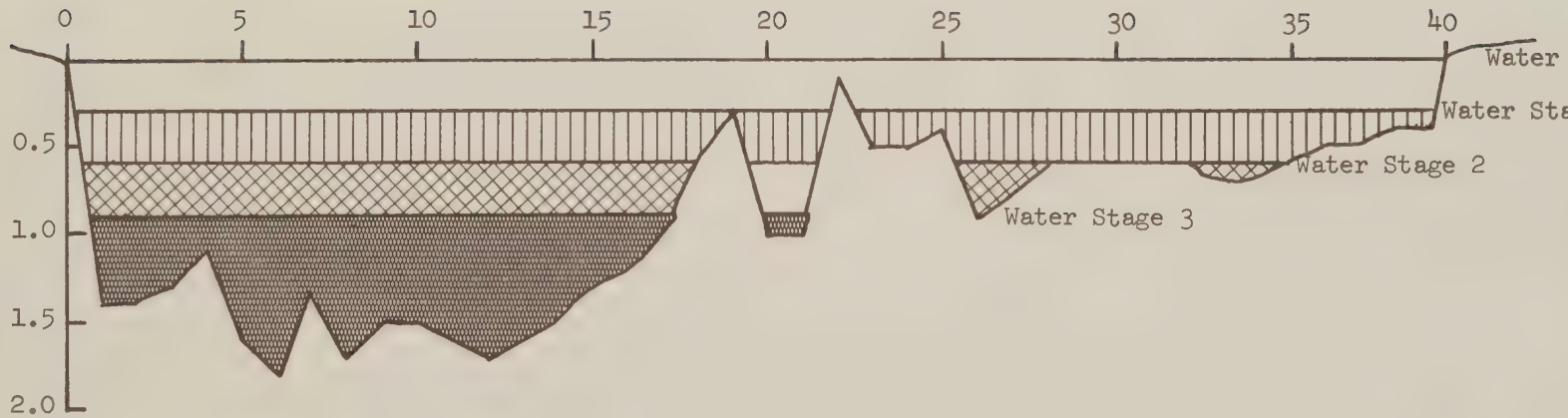

Figure 69
YELLOWSTONE RIVER
Statuib #3A - 1/8 mile below
Swift Creek Campground

Water Stage	Discharge	%	Velocity	%	Max. Depth	%	Ave. Depth	%	Area	%	Water Surface	%	Wetted Perimeter	%	Habitat Retained	%
0	76.4 cfs	100	2.06 fps	100	1.8 ft	100	0.9 ft	100	37.05 sqft	100	41.3 ft	100	41.3 ft	100	49% opt	100
1	44.28 cfs	58	1.69 fps	82	1.5 ft	83	0.7 ft	78	26.20 sqft	71	36.9 ft	95	39.1 ft	95	44% opt	89
2	18.67 cfs	24	1.33 fps	65	1.2 ft	67	0.4 ft	44	14.04 sqft	38	27.5 ft	71	30.1 ft	73	31% opt	63
3	13.02 cfs	17	1.18 fps	57	0.9 ft	50	0.4 ft	44	11.04 sqft	30	17.6 ft	46	28.2 ft	68	26% opt	53

Station 2, Yellowstone River

The habitat trend-discharge relationship as illustrated in figure 70 indicates a gradual, steady decline of habitat values until a more rapid loss is evident at a reduced flow of approximately 30 cfs. Streambottom features at three water stages reduced from the base-measured flow of about 83 cfs is illustrated in Figure 71. The flow at Station 2 also includes accretion flows from Swift Creek and generally indicate an additional increase in discharge between Stations 3A and 2. The recommended habitat requirement of 30 cfs would normally be exceeded resulting in enhancement of the fishery.

Figure 70
YELLOWSTONE RIVER
Station #2 - 3/4 miles below River View
Campground and 400 yards west of wood

100% of Field-Measured Values	
Water Surface	48.2 ft
Wetted Perimeter	50.5 ft
Maximum Depth	2.0 ft
Average Depth	1.2 ft
Discharge	82.04 cfs
Velocity	1.39 fps
Pools rated 1,2,3	13% sample
Habitat	50% optimum

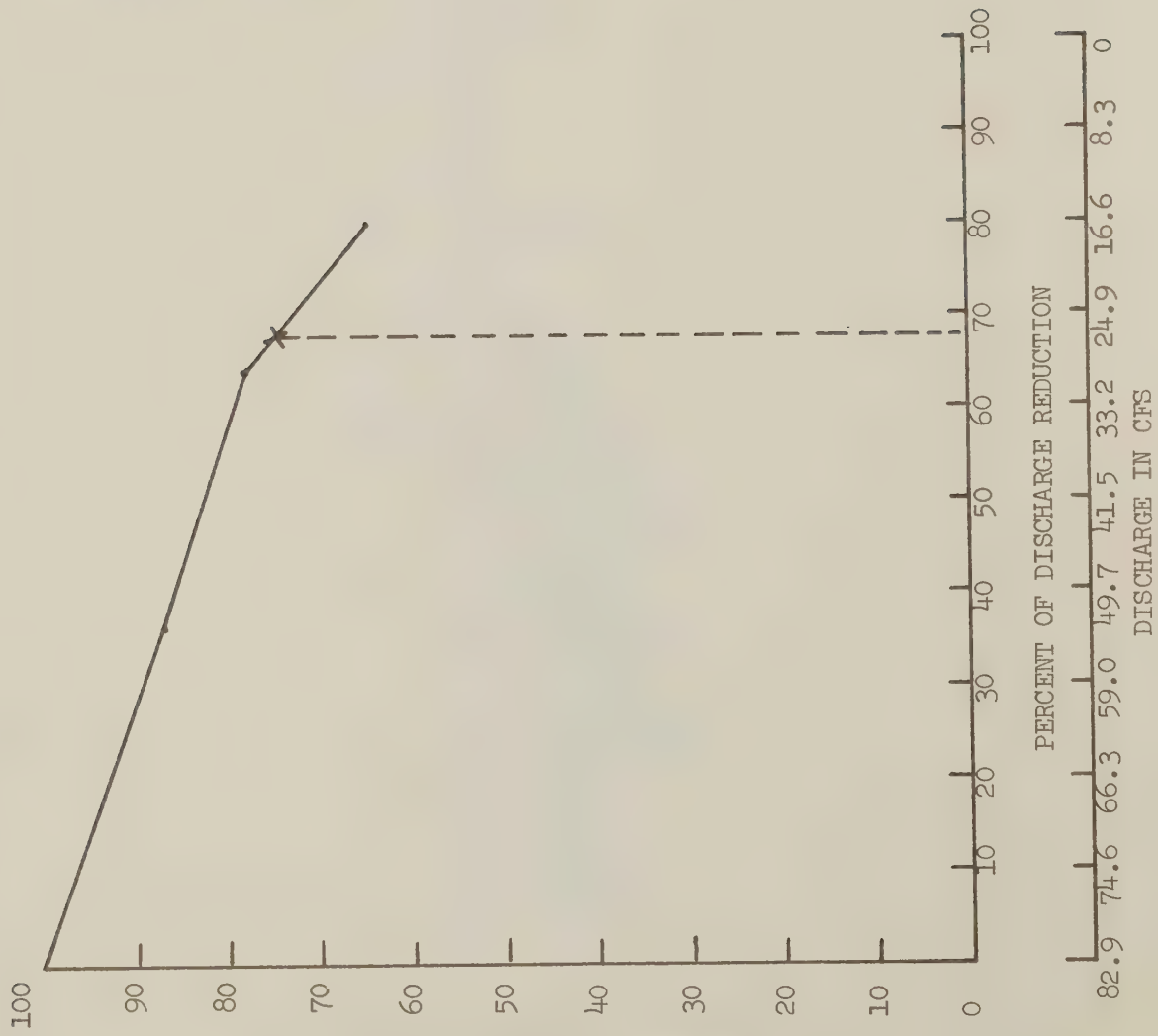

Figure 72
YELLOWSTONE RIVER

Station #2 - 3/4 miles below River View Campground and 400 yards west of wood

Scale:
Horizontal 1" = 10 ft
Vertical 1" = 1 ft

Water Stage	Discharge	%	Velocity	%	Max. Depth	%	Ave. Depth	%	Area	%	Water Surface	%	Wetted Perimeter	%	Habitat Retained	%
0	82.9 cfs	100	1.39 fps	100	2.0 ft	100	1.2 ft	100	59.18 sqft	100	48.2 ft	100	50.5 ft	100	50% opt	100
1	52.70 cfs	64	1.20 fps	86	1.7 ft	85	0.9 ft	75	43.92 sqft	74	45.3 ft	94	46.9 ft	93	44% opt	87
2	29.55 cfs	36	0.98 fps	71	1.4 ft	70	0.8 ft	67	30.16 sqft	51	38.4 ft	80	43.4 ft	86	39% opt	78
3	16.84 cfs	20	0.81 fps	58	1.1 ft	55	0.5 ft	42	20,80 sqft	35	35.6 ft	74	39.7 ft	79	33% opt	65

VI. CONCLUSION

The development of water uses for the Central Utah Project will have a serious, harmful impact on streams affected by dams, diversions, and the manipulation of water between river basins.

The aquatic habitat necessary for the survival of existing natural fisheries and food organisms will be substantially deteriorated if low winter flows are completely diverted for the Central Utah Project. Dewatering of these streams will reduce food-producing riffle areas to dry rock and overwintering pools to a fraction of their depths thus significantly negating their value during the winter periods. Pools without flowing water become deathtraps for fish as evidenced in the lower Provo River when existing flows are periodically diverted for power and irrigation purposes.

The projected minimum flows and subsequent changes in the aquatic habitat, because of planned diversions, reflect water requirements for the existing stream channels. They are not meant to convey what these reduced flows mean in terms of fishery production.

Several study projects have shown the surface area of streams can be reduced with proper structures to create favorable pools and adequate cover. These two criteria are primary factors, even more than food, for trout production in streams. This report is intended to show that retention of the aquatic habitat is essential to conserving indigenous trout populations. The basic axiom implies that without aquatic habitat there is no natural fishery.

Further investigation is needed to determine the application of management techniques which could provide enhancement possibilities to improve the habitat by creating adequate pools and cover.

The annual storage of 6,500 acre-feet of water in Upper Stillwater Reservoir for downstream releases in Rock Creek and Strawberry River is inadequate for these two streams alone. A commitment to provide 25 cfs in Rock Creek at the Ute-Ouray Indian boundary below Lower Stillwater Reservoir will vary in release requirements up to 7,000 acre-feet. Demands on this 6,500 acre-feet above the average programmed release of 3,500 acre-feet in Rock Creek will reduce downstream flows in Strawberry River. Releases for other streams in the Bonneville Unit along the Strawberry Aqueduct will be unavailable.

The collection and storage of low winter flows and high spring runoff water can be accomplished without complete degradation of the aquatic environment. The recommended releases below proposed diversion points or reservoir dam sites are essentially minimum flows necessary to sustain the aquatic habitat and preserve the natural fisheries. The objectives of the Central Utah Project should not be considered paramount to the complete annihilation of a valuable resource.

VII. APPENDIX

List of References

a/ Stream Fishery Studies, White River Survey, July 11, 1962, to April 15, 1963. Project No. F-26-R-1, Job No. 2, State of Colorado.

b/ Utah Fishery Waters Inventory and Classification. Department of Natural Resources, Division of Wildlife Resources. August 1970.

c/ USGS Paper 441, Flow Duration Curves. Water Resources Data for Utah. Surface water records. U.S. Department of the Interior, Geological Survey.

Table 2

STREAM DISCHARGE STATIONS AND MEASURED FLOWS

Stream	Date Surveyed	Sta.	Dis-charge	Sta.	Dis-charge	Gain or Loss	Sta.	Dis-charge	Gain or Loss	Sta.	Dis-charge	Gain or Loss	Sta.	Dis-charge	Gain or Loss	Recommended Flow
Rock Creek	10/10/62	1	67.30	2												20 c.f.s. from Upper Stillwater Reservoir
	10/10/63		52.07													
	10/7/64				35.1											
	11/19/64		49.53													
	10/7/65		23.73													
	11/19/65				59.11											
Currant Creek	10/9/62	1	5.021	2	9.972	+4.951	3	10.010	+0.038	4	13.343	+3.333				5 c.f.s. from Currant Creek Dam
	10/6/64		5.20		7.717	+2.517		7.992	+0.275		10.301	+2.309				
	11/18/65		14.138		18.915	+4.777		20.464	+1.549		24.63	+4.166				
Yellowstone Creek	10/31/63	5	35.0	3A			2			1						25 c.f.s. below Boneta Diversion to Sta. 1. 14 c.f.s. below Uintah Aqueduct on Tawanta Dam
	10/18/63				76.5			82.9	+6.4		36.7	-46.2				
	10/16/64				48.665			50.422	+17.57		9.769	-40.65				
	10/31/67		27.73		72.61	+44.88		61.57	-11.04		12.32	-49.25				
	11/15/68		21.564		53.575	+32.011					13.202					
Lake Fork	10/29/63	1	10.41													17 c.f.s. from Moon Lake Reservoir to Taskeech Reservoir
	10/19/64		11.575													
	10/11/65		20.096													
	10/30/67		11.90													
	11/15/68		10.32													
Whiterocks	10/14/64	1A	32.85													17 c.f.s. release from Whiterocks Reservoir
	10/18/67		46.21													
	11/13/68		24.457													
Uinta River	10/3/63	4		1	126.0		2	156.7	+30.7	5			6			Uinta Aqueduct below Burro Dam to Sta. 5 40 c.f.s. Sta. 6
	10/15/64		38.531		35.74	-2.79		62.61	+26.87							
	10/6/65		107.459		114.25	+6.79		134.281	+20.03							
	10/19/67		57.46		59.27	+1.81		94.61	+35.34		54.33	-40.28		55.82	+1.49*	
	11/14/68										17.572			54.935	+37.36	
Little Brush Creek	9/10/63	1	3.35	2	2.06	-1.29	3	2.40	+0.34							4 c.f.s. from East Park Reservoir Enlargement
	10/8/64		2.28		1.46	-0.82		1.04	-0.42							
	10/8/65		7.94		8.831	+0.89		8.914	+0.83							
	10/12/67		2.76		2.80	+0.04		2.78	-0.02							
	10/28/68		1.31		1.65	+0.34		1.82	+0.17							
Big Brush Creek	9/16/63	3	1.8	2	0.4		1	7.09	+6.01							3 c.f.s. from Oaks Park Reservoir for stream section above Brush Creek Cave. Natural flow from Brush Creek Cave to Forest boundary approximately 7 to 12 c.f.s.
	10/9/64		2.33		0.2			8.87	+6.54							
	10/12/65		4.77		0.279			10.81	+6.04							
	10/12/67		4.40		0.84			12.20	+7.80							
	11/1/68		6.093		0.611			11.63	+5.54							
	10/22/69		2.415		1.209			10.87	+8.45							

Stream	Date Surveyed	Sta.	Dis-charge	Sta.	Dis-charge	Gain or Loss	Sta.	Dis-charge	Gain or Loss	Sta.	Dis-charge.	Gain or Loss	Sta.	Dis-charge	Gain or Loss	Recommended Flow
Ashley Creek	9/12/63	5		4	10.3		1	18.10	+7.80	1A			3	13.3		5 c.f.s. below Leidy Dam
	10/13/64				7.3						7.76			23.019	+15.26	
	10/19/65		13.145		27.815	+14.67								21.383		
	10/11/67		5.14					17.30			15.09	-2.21		25.71	+10.62	
	10/29/68		3.19		12.98	+9.79		9.06	-3.92		7.28	-1.78		60.63**	+53.35	
	10/23/69		4.6881											2.035		
	10/29/70				7.516			26.415	+18.90		5.049	-21.37		6.809	+1.76